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Volume 79

1965

THE OTTAWA FIELD-NATURALIST' CLUB

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THEIR EXCELLENCIES THE GOVERNOR GENERAL AND MADAME VANIER

The objects of the club are to foster an acquaintance with and a love of nature, to encourage investigation and to publish the results of original research and observations in all branches of natural history.

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A REQUIEM FOR DOW'S SWAMP

C. H. D. CLARKE

Fish and Wildlife Branch, Ontario Department of Lands and Forests, Toronto, Ontario

WHEN I WENT TO OTTAWA some years ago, I boarded downtown, and had no place to go. When free, I walked, in a disoriented way, the old path known to lovers and rubbydubs, on the face of the embankment below and behind the Parliament Buildings. The present generation will recognize only the barrier, by which, presumably, the safety of our law-makers was at one time preserved from the minions of Hitler, and the re-opening of which might make a good Centennial project. In due time my residence became more or less continuous, and I migrated to quarters in the Glebe. It was all very convenient, but a little more urban than I had ever been used to. There was one consolation. I discovered Dow's swamp only a short walk away.

There, among the cedars, willows, alders and elms, in tangled glades that led over sodden ground to beds of cattails, were the white-throat and the veery. There the alder flycatcher luxuriated among the mosquitoes, and one could sort out the water-thrush from the mourning warbler by song, and the purple finch from the warbling vireo. There were enough tall trees on the side of the Bronson hill to hold a pair or two of scarlet tanagers, and enough water and cattails near the railway tracks for a colony of short-billed marsh wrens, and even, by times, a pair of black ducks.

At various times I suspected the Lincoln sparrow, rusty blackbird, and ruby-crowned kinglet of nesting, but when the time came to find out for sure I always seemed to find myself listening to a different lot of bird songs in some place far away from Ottawa. It is too late now, and has been so for quite a few years.

I don't know who Dow was, or when the swamp got its name. Quite obviously there was a time when a rather large cedar swamp occupied low ground to the north of the bend of the Rideau and drained into it between the higher areas later to become Ottawa South and the Experimental Farm. I daresay that a search of letters and documents might well show that deer were hunted there, and bears slept the winters out beneath the tangles of roots and fallen trees, just as they do now in other cedar swamps. Long before the community became sophisticated enough to have naturalists, all this was altered by the building of the Rideau Canal, which took advantage of this and other depressions to leave the river behind at the Hog's Back and make its separate way to the Ottawa. Above the canal embankment, the original swamp became Dow's Lake. A remnant, between the embankment, which later carried a

Mailing date of this number May 11, 1965

road, and a railway track, and the Rideau, became the Dow's swamp of generations of naturalists.

The National Herbarium is rich in plants collected there, and the pioneer botanists found it quite early. I venture to say that invertebrate collections likewise have many a Dow's swamp specimen, because the place had both numbers and variety of everything. At the same time, there are not so many mammal and bird specimens. They are more generally recognizable, and recognized, than collected, and, as befits a capital, Ottawa's backyard was the whole Dominion. When it comes to records, I suspect that the botanists have the most interesting assemblage. Swamp lists must comprise most of the fauna and flora of Ottawa, and there is no point in trying to compile one here. The common birds were never kept separate. Time alone will tell what will be lost.

Plants cannot skulk or hide, or avoid flower-pickers, children, or work boots, or, if they are the least bit sensitive, cope with the city miasma. I don't think there was anything really unusual in the plant life left in the swamp when I first knew it. With birds, you might still, even today, find something among the piles of fill and the forlorn little stumps.

One notes that the naturalists still have excursions. I suspect that they are at such a level as they were when I knew them. There was an earlier time when O.F.N.C. excursions were major social events. It is surprising that a small city of business men, and a few scientists whose salaries showed clearly that it was the job that mattered, produced a stronger interest in natural history than today's aggregation of culture and brains, but the great of the land knew Macoun and Hewitt and others, and the near-great were happy to be recognized by them. Dr. Gibson, so long Naturalist Club treasurer, spoke to me more than once of Club excursions up the Gatineau on special trains, when the bills and silver for the one dollar tickets, sometimes $1200 worth, filled pockets and satchel to overflowing, as he swung on board ahead of the conductor. When I first joined, and before I came to Ottawa, The Canadian Field-Naturalist carried an advertisement whose wording caught the eye—Dr. Mark G. McIlhenny, "Dentist to Certain of the Cognoscenti". When I mentioned it later, I evoked an obvious nostalgia on all sides for the Club excursions once held in his cruiser on Dow's Lake.

Over the years there were many excursions to Dow's Swamp, but by my time they had shrunk to less than one a year. I wonder when the last one was! The place had begun to look seedy, with old boots and bottles, and an active dump at one end. The dump wintered an extraordinary flock of pheasants, for Christmas bird censuses. It also sustained, in the swamp, one of Ottawa's Hoovervilles, the very look of which, and of the inhabitants, was enough to keep some naturalists away. I found the hobos harmless enough, even friendly, once it was clear that bird-watching and eviction were unrelated, even though their great preoccupation with cheap wine made them a little uncertain. I learned from one that a search of the river flats, where the snow from downtown streets was dumped, could sometimes produce enough coin for a bottle. When eviction finally came, one of them left behind an army of cats which lived wild for several generations, raising kittens in logs and under stumps.

About that time the Federal District began to take an interest, and reports in the paper spoke about the place as a haunt of birds. One day a band of workmen went in and levelled all the trees and shrubs in a swath of one hundred feet across the swamp. Now, as I stated, the Naturalists were using the place less and less for official activities, but there was still enough naturalist activity at the private level that this action had hardly begun before it had caused a frantic fluttering in the dovecotes. In due course a delegation, led by the redoubtable Dr. Harrison F. Lewis, waited on the Commission, and gave them a long discourse on the swamp and all it meant – putting in, no doubt, all the important things that I have left out. The discourse was interrupted by an impatient Federal District Chief, who protested, "But we're making the place into a bird sanctuary!"

The work stopped, but whether there was ever official comprehension, I know not. Whenever did the man of the drawing board and the bulldozer leave a piece of land alone? It was surely a better bird sanctuary long ago when it was a mile from the city and open to hunting, than when the city put a protecting hand on it, as when I knew it. However, I was grateful for what I knew.

At that stage I left Ottawa, but I am told that when the Bronson Avenue extension was built the naturalists gave up. Dow's Swamp belonged to another world, and is being literally interred at this time of writing. A soil core of the future will show a layer of humus twenty feet or so down, carbon-datable to a period in the middle of the twentieth century. The new generation of Ottawans live far beyond it, and any who feel so inclined can drive to a dozen other Dow's Swamps. If they do, they are most unlikely to get on such intimate terms with any of them as those who walked – I remember some bicycles also – in times past. Dow's Swamp made naturalists. In the days of mutton-chop whiskers and beaver hats, I suppose that nearly all the scientific Ph.D's in Ottawa belonged to the Naturalists. If the same thing were true now, what a Club there would be!

Dow's Swamp had a combination of nearness and quality. I doubt if you could find a Lincoln sparrow on territory in the Mer Bleu, for example. You could find something else, no doubt, but you couldn't walk to it. A future historian of Ottawa natural history could find out where it was, and something of what it was as a natural community. My purpose is to help him get a more personal feeling for it.

I dare say there is a plan for the use of the newly-filled land, bleak and bare in its triangle between roads, but I have not seen it. I suggest, however, that if a new flag is to be unfurled, symbolizing a complete break with the past, then this would be a good place to hoist it.

Fish and Wildlife Branch,

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TWENTY-THREE YEARS OF BAT BANDING IN ONTARIO AND QUEBEC

Harold B. Hitchcock
Department of Biology, Middlebury College, Middlebury, Vermont

This study of bats in summer colonies and hibernating populations in Ontario and Quebec was begun in 1939. Except for a limited amount of banding in 1961 summer activities ended in 1941, but visits to the larger winter colonies were made most years through 1962. A report on hibernation has already been made (Hitchcock, 1949) and two on homing (Hitchcock and Reynolds, 1942, and Reynolds, 1942). The present article is intended to summarize the banding and to record incidental observations made during the study. With the increasing popularity of bats as research material in laboratories, the growing interest in caving as a sport (with attendant disturbance of hibernating bats), and the present threat to vulnerable bat populations resulting from the discovery of the role of bats as carriers of the rabies virus, the presentation of these data may be of value in showing, at least for the earlier years, the composition and survival of hibernating populations in a relatively undisturbed state.

In the early part of the study undergraduate students at the University of Western Ontario, including Rae Brown, Lee Marsh, William Morris, Keith Reynolds and Rodger Standfield assisted. More recently Middlebury College students, including Hilton Bicknell, John Beauregard and Hans Neuhauser, have helped. The National Museum of Canada and the Royal Ontario Museum of Zoology both assisted at the start. Dr. A. W. F. Banfield censused bats at St. Pierre de Wakefield in 1948 and 1949. Dr. Donald A. Smith provided the Craigmont statistics for December 1963. Bands were supplied by the Fish and Wildlife Service, Department of the Interior, Washington. Financial assistance was received at various times from the University of Western Ontario, the American Academy of Arts and Sciences and the National Science Foundation, but for the most part the study was not subsidized.

Five species were banded: *Eptesicus f. fuscus*, the big brown bat; *Myotis keenii septentrionalis*, the long-eared little brown bat; *Myotis l. lucifugus*, the little brown bat; *Myotis subulatus leibii*, the least or masked bat; and *Pipistrellus subflavus*, the pipistrelle. All five species were banded during hibernation, but only *M. lucifugus* and *Eptesicus* at summer colonies. One summer colony of *M. subulatus leibii* was discovered during the study, but colonies of *M. keenii* and *Pipistrellus* have not yet been reported in Ontario or Quebec.

Statistics for banding at summer colonies are given in Table 1. Most of the summer banding was done in the Western Ontario peninsula. Although many of the banded bats were retaken by us during the study, only six were reported by casual finders. One immature female little brown bat, banded August 3, 1939, at Dover Township, Kent County, Ontario, and released the next day at London, was picked up at Mitchell, September 28, 1939, 32 miles

TABLE 1.—Banding at summer colonies.

Date	Province	*Myotis lucifugus*		*Eptesicus fuscus*	
		male	female	male	female
1939	Ontario	55	627	1	1
1939	Quebec	14	32	–	–
1940	Ontario	73	854	51	111
1941	Ontario	27	191	4	31
1962	Ontario	11	57	1	6
1962	Quebec	3	3	–	–
		183	1,764	57	149

from the release point and 90 miles from its colony. Because this young bat had been displaced from its colony, the record is of dubious significance. Five big brown bats taken at Delaware, Ontario, August 6, 1940, and released at London, five miles distant, were reported. Two adult females were taken at Mount Bridges, three miles from the colony. One was hibernating in a cellar, January 2, 1941; the other was active on August 24, 1941. Two were found in London, in December, 1941, and March, 1942, respectively. The most interesting recapture was that of a male, banded as a juvenile, found at Delaware ten years later, on May 25, 1950, in another building.

Data on winter banding are given in Table 2. Unless otherwise indicated the figures represent essentially the whole population seen on the date of the visit. (See Hitchcock (1949) for complete population figures, 1939-47.) Most of the banding was done at three natural caves and two abandoned mine tunnels. The caves are at Fourth Chute (Knightington), Renfrew County, Ontario, in Tyendinaga Township, Hastings County, Ontario, and at St. Pierre de Wakefield, Gatineau County, Quebec. The Quebec cave has long been commercialized; the one at Fourth Chute was commercialized in 1955. The tunnels are at Craigmont, Renfrew County, Ontario, and at Eldorado, Hastings County, Ontario. The caves and Craigmont mine have been described previously, as well as characteristics exhibited by each species during hibernation (Hitchcock, 1949). The Eldorado tunnel is half a mile west of the village; it is about 60 feet long.

The caves are modest in proportions, permitting the collection of almost all bats seen. At Craigmont no attempt was made to band all the bats. Here, after the first visit, the major effort was to find as many as possible of the banded individuals. On the most thorough search made there, December 16, 1962, it is estimated that 10% of the banded bats could have been overlooked, for many were in dense clusters, often in deep pockets (bootjacks), in which the bands would not show.

Populations of hibernating bats are not static. In addition to the building up of numbers in the fall and their reduction in the spring two other changes occur — additions and withdrawals throughout the winter and the entrance

TABLE 2.—Hibernating populations. (New: band placed on bat. old: banded bat retaken *entire visible population not handled. **approximately 50 *Eptesicus* released unbanded)

		Eptesicus		*M. keenii*		*M. lucifugus*		*M. subulatus*		*Pipistrellus*		Total
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
St. Pierre de Wakefield, Que.												
11/25/39	new	20	2	12	3	3	1	–	–	–	–	41
1/18/41	new	22	8	18	1	2	2	–	–	–	–	53
	old	14	1	2	–	–	–	–	–	–	–	17
4/4/42	new	–	–	4	–	55	24	–	–	2	–	85
	old	–	2	1	–	1	2	–	–	–	–	6
12/19/42	new	11	7	6	2	–	–	–	–	–	–	26
	old	13	4	1	–	–	1	–	–	–	–	19
3/5/45	new	11	5	1	–	27	4	–	–	–	–	48
	old	16	2	–	–	–	1	–	–	–	–	19
12/13/46*	old	7	1	–	–	–	–	–	–	–	–	8
2/7/48*	old	7	–	–	–	–	–	–	–	–	–	7
2/20/49*	old	4	–	–	–	–	–	–	–	–	–	4
12/21/49	new	3	1	8	–	–	–	–	–	1	–	13
	old	2	1	1	–	–	–	–	–	1	–	5
2/23/50	new	2	–	2	1	3	–	–	1	–	–	9
	old	5	–	1	–	–	–	–	1	1	1	6
12/17/58	new	2	–	–	–	3	–	–	–	1	–	6
Total	new	71	23	51	7	93	31	–	1	4	–	281
	old	68	11	6	–	1	4	–	1	2	1	94
Tyendinaga, Ont.												
1/17/41	new	1	1	–	–	48	10	–	–	5	–	65
4/11/41	new	–	1	–	1	82	30	1	2	2	–	119
	old	–	–	–	–	11	2	–	–	1	–	14
4/3/42	new	–	–	–	–	80	33	–	–	7	–	120
	old	–	–	–	–	32	4	–	–	–	–	36
4/11/43	new	–	–	1	–	68	34	–	1	3	3	110
	old	–	–	–	–	29	4	–	1	1	–	35
2/28/45	new	–	7	–	–	13	8	1	–	–	–	29
	old	1	–	–	–	12	3	–	–	–	–	16
11/27/47	new	–	–	–	–	8	1	–	–	9	2	20
	old	–	1	–	–	6	1	–	–	–	–	8
4/9 and 4/14/48	new	–	–	1	–	60	3	–	–	1	–	65
	old	–	–	–	–	19	1	–	–	5	–	25
12/23/49	new	–	4	–	–	10	5	–	3	7	–	29
	old	–	–	–	–	7	–	–	–	–	–	7
2/1/53	new	–	1	1	–	78	20	–	3	5	4	112
	old	–	–	–	–	9	1	–	–	–	–	10
2/18/56	new	–	1	–	–	233	66	–	1	2	–	303
	old	–	–	–	–	17	1	–	–	–	–	18
4/8/58	new	–	–	–	–	132	42	1	–	–	–	175
	old	–	–	–	–	25	2	–	1	–	–	28
12/19/58	new	–	–	–	–	50	11	–	–	–	–	61
	old	–	–	–	–	37	4	–	–	–	–	41
12/15/59	new	1	3	–	–	13	2	–	1	–	–	20
	old	–	1	–	–	34	1	–	–	–	–	36
2/24/61	new	–	3	1	–	19	6	1	–	2	3	35
	old	–	–	–	–	26	3	–	–	–	–	29
12/17/61	new	1	–	–	1	4	5	–	1	1	–	13
	old	1	1	–	–	11	2	–	–	–	–	15
12/17/62	new	–	–	–	–	2	1	–	–	–	1	4
	old	–	–	–	–	2	–	–	–	–	–	2
Total	new	3	21	4	2	900	277	4	12	44	13	1280
	old	2	3	–	–	277	29	–	2	7	–	320

TABLE 2.—cont'd.

		Eptesicus		*M. keenii*		*M. lucifugus*		*M. subulatus*		*Pipistrellus*		Total
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
Fourth Chute, Ont. 4/5/42	new	27	7	2	4	–	–	15	9	6	–	70
1/6/43**	new	107	27	13	5	–	–	31	28	–	–	211
	old	20	2	–	–	–	–	3	2	1	–	28
2/26/44*	new	80	26	–	–	–	–	29	29	–	–	164
	old	59	12	–	–	–	–	17	5	1	–	94
2/25/45	new	41	21	7	5	–	–	25	27	5	–	131
	old	96	21	–	–	–	–	16	11	–	–	144
1/20/46*	old	70	18	–	–	–	–	5	4	–	–	97
1/4/47	new	8	1	15	4	–	–	32	25	5	2	92
	old	23	2	–	–	–	–	10	3	–	–	38
11/29/47	new	7	1	13	2	–	–	10	3	6	1	43
	old	10	1	1	–	–	–	3	–	1	–	16
12/22/49	new	14	10	12	5	–	–	18	11	10	1	81
	old	5	–	2	–	–	–	7	1	–	–	15
2/24/50	new	24	10	1	–	1	–	18	9	–	1	64
	old	33	7	–	–	–	–	5	7	2	–	54
2/20/53	new	19	19	5	1	–	–	34	64	1	1	144
	old	12	5	–	–	–	–	8	7	1	1	34
11/26 and	new	4	–	9	2	–	–	1	–	4	–	20
11/28/53	old	3	1	1	–	–	–	–	1	–	–	6
2/17/56	new	18	5	–	4	–	–	43	54	6	2	132
	old	5	2	1	–	–	–	5	7	–	–	20
4/9/58	new	–	1	1	–	–	–	–	–	–	–	2
	old	–	1	1	–	–	–	–	–	–	–	2
12/17/58	new	–	1	36	4	–	–	13	9	5	1	69
	old	1	–	1	–	–	–	6	3	–	–	11
12/15/59	new	2	–	8	3	–	–	5	9	–	1	28
	old	4	–	7	–	–	–	3	2	1	–	17
2/26/61	new	10	–	2	1	1	–	10	7	1	–	32
	old	2	1	1	–	–	–	5	4	–	–	13
12/19/61	new	1	–	14	5	–	1	6	–	–	–	27
	old	1	–	2	–	–	–	2	2	–	–	7
Total	new	362	129	138	45	2	1	290	284	49	10	1310
	old	344	73	17	–	–	–	95	59	7	1	596
Craigmont, Ont. 2/26/45*	new	–	–	4	1	168	41	–	–	–	–	214
11/28/47*	new	–	–	12	3	490	106	–	–	–	–	611
	old	–	–	–	–	10	3	–	–	–	–	13
2/20/53*	old	–	–	–	–	86	5	–	–	–	–	91
11/27/53*	new	–	–	44	5	230	58	–	–	–	–	337
	old	–	–	–	–	80	2	–	–	–	–	82
4/9/58*	new	–	–	–	–	498	149	–	–	–	–	647
	old	–	–	2	–	97	8	–	–	–	–	107
12/18/58*	new	–	–	–	–	50	–	–	–	–	–	50
	old	–	–	–	–	372	36	–	–	–	–	408
12/16/59*	new	–	–	–	–	197	50	–	–	–	–	247
	old	–	–	–	–	291	26	–	–	–	–	317
2/25/61*	new	1	1	18	9	100	48	–	–	–	–	177
	old	–	–	–	–	137	13	–	–	–	–	150
12/18/61*	new	–	–	–	–	500	96	–	–	–	–	596
	old	–	–	–	–	231	23	–	–	–	–	254
12/16/62*	old	–	–	–	–	520	59	–	–	–	–	579
12/14/63*	old	–	–	–	–	262	25	–	–	–	–	287
Total	new	1	1	78	18	2233	548	–	–	–	–	2879
	old	–	–	2	–	2086	200	–	–	–	–	2288

TABLE 2.—cont'd.

		Eptesicus		*M. keenii*		*M. lucifugus*		*M. subulatus*		*Pipistrellus*		Total
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
Eldorado, Ont.												
4/9/48	new	–	–	–	1	–	2	–	–	1	–	4
12/23/49	new	1	14	1	3	1	–	–	2	–	–	22
	old	–	–	–	–	–	1	–	–	–	–	1
2/21/53	new	2	2	–	–	–	–	–	3	–	–	7
	old	–	3	–	–	–	1	–	–	–	–	4
2/18/56	new	3	2	–	–	1	–	8	9	–	–	23
	old	1	4	–	–	–	–	–	–	–	–	5
4/8/58	new	–	–	3	1	–	–	–	–	–	–	4
	old	1	–	–	–	–	–	–	–	–	–	1
12/15/59	new	–	3	5	3	–	1	–	–	–	–	12
	old	2	1	1	–	–	1	1	2	–	–	8
2/24/61	new	–	2	–	–	–	2	1	6	–	–	11
	old	–	2	–	–	–	–	3	1	–	–	6
2/17/61	new	1	1	–	–	–	–	–	–	–	–	2
	old	–	3	1	–	1	–	2	4	–	–	11
12/17/62	new	1	–	–	–	–	–	2	4	–	–	7
	old	–	–	–	–	–	–	2	1	–	–	3
Total	new	8	24	9	8	2	5	11	24	1	–	92
	old	4	13	2	–	1	3	8	8	–	–	39
(Various) Ont. 1939–50	new	1	4	1	1	3	–	–	–	9	1	20
Total banded		446	202	281	81	3233	862	305	321	107	24	5862
Percentage		69	31	78	22	79	21	49	51	82	18	

of transients in the spring. The shifting in and out of bats throughout the winter would usually not be noticed except for the bands, for the net change in numbers may not be marked. The same is sometimes true in the case of spring migrants, but the latter may be conspicuous, as was the case at St. Pierre de Wakefield on April 4, 1942, when 82 little brown bats were found. On midwinter visits the number of this species found here never exceeded four. Only one of these April bats was recaptured, again in the spring, on March 15, 1945.

Examples of shifting in and out during the winter were noted in *Eptesicus*, *M. lucifugus* and *M. subulatus*. At Fourth Chute on December 22, 1949, 29 *Eptesicus* and 47 *M. subulatus* were found, but nine weeks later, on February 24, only 15 of the former and three of the latter were recaptured. Fifty-nine new big brown bats and 36 least bats had appeared. At Tyendinaga on January 17, 1941, 58 little brown bats were banded, of which only 13 were recaptured three months later, on April 17. One hundred and twelve new bats were found at this time.

Bats captured during the winter are retaken irregularly in subsequent years. This may reflect the shifting phenomenon noted above. How-

ever, in natural caves there may be areas of which the collector is ignorant. Passages too small for him to crawl through may lead to places suitable for hibernation; small cracks and crevices may be deceptively commodious. At Tyendinaga, for example, three bats were visible in a crevice. When they had been removed, 29 others were found behind them.

Rarely does one find a population of hibernating bats in which a few individuals are not active. Occasionally a bat may be seen in flight outside the cave, near the entrance, but more often active individuals are found inside, flying or grooming themselves. At Fourth Chute, where the cave had active circulation of air prior to its commercialization, the distribution of *Eptesicus* and *M. subulatus* varied with the temperature. Usually both species were close to the entrance, but in very cold weather they were in more sheltered places, as on January 4, 1947, when the temperature outside was —30° F. On December 22, 1949, on the other hand, during a protracted period of unseasonable, warm weather, both species were greatly reduced in numbers. It seems reasonable to assume that some had left the cave. In Holland, Bels (1952), who has been perplexed by the turnover phenomenon, concludes that bats find shelter in places other than recognized caves. One can assume that some of these places provide sufficient protection during moderately cold weather but become inadequate in severe winter weather. In the Canadian region under consideration such places would include fissures in rock outcroppings uncovered by snow, trees and buildings. The possibility that other caves are nearby but as yet unknown cannot be eliminated.

Griffin (1940) has reported little brown bats moving from one cave to another during the season of hibernation. Only one questionable instance of such a shift was observed in this study. On December 15, 1959, a male little brown bat that had originally been banded at Tyendinaga the preceding winter was recaptured and released along with others at the mouth of the cave. The next day at Craigmont, 70 miles distant, the same band number was recorded for a male little brown bat. In each case the band was noted to be in good condition, not mutilated by chewing or overgrown by flesh. The temperature on the night in question was slightly below freezing. The fact that no other instance of changing winter quarters was discovered during this study suggests the probability of human error here.

Except at Craigmont there has been a decline in the size of populations. My first visit to Craigmont was soon after workmen had killed many bats by hosing the walls preparatory to reactivating the mine. Fortunately mining was not resumed there. However, in 1962 and 1963 many bats, including 146 banded ones, were removed by a provincial public health employee during an investigation of the incidence of rabies in bats. At the cave at St. Pierre de Wakefield the proprietor, Mr. Zephir Lafleche, tried to protect the bats, but in the winter of 1949-50 most of them were removed. At Fourth Chute bats have been collected for laboratory experimentation and other purposes. In 1946, for example, 65 specimens (4 species) are known to have been removed. The blocking of natural openings into this cave, beginning when it was commercialized in 1955, has destroyed the conditions that made it preeminently

suitable for *Eptesicus* and *M. subulatus leibii.* At Tyendinaga variation in numbers has been great, but the recent trend has been downward.

Banding itself may cause the death of some bats. The bands are designed for the scaled legs of birds. On bats, whether the band is applied to the leg, the technique I employed until 1943, or to the arm, as I have done since then, sharp edges come in contact with the flesh of the appendage and flight membrane. Band corners cut into the skin, causing it to overgrow the band sometimes. Although one little brown bat in this study whose band became completely overgrown survived 20 years, others may not have fared so well. Experimental bands lacking sharp corners have been used with encouraging results recently. Ear tags were tried but found unsatisfactory.

A few bats were kept as specimens. Most of these are now in the collections of such institutions as the Royal Ontario Museum of Zoology (Toronto), the National Museum of Canada (Ottawa), and the United States National Museum (Washington).

Predation was noticed occasionally. In most cases the remains of the victim consisted only of skin and wings, but on November 17, 1953, at Craigmont four bodies were found on the floor close to each other. The intestines of these bats had not been consumed. Nearby a mouse, *Peromyscus leucopus noveboracensis*, was caught. This is the only occasion on which a mouse was seen where bats were hibernating. As some bats were hanging on walls a mouse could climb without trouble, this mouse is suspected of being the killer. A few dead bats were found in the flooded part of the Craigmont mine, beautifully haloed with water mold. How they died is not known, for bats float and swim well. In New York I have found bats imbedded in ice on the floor of a cave. These I assume had been trapped by becoming frozen to the surface, perhaps while trying to drink, or after being knocked down. At Craigmont flooding increases during the winter as ice builds up at the mouth of the tunnel. Bats at first frozen to the floor might then float free when thawed out. One bat was found impaled on a strand of barbed wire strung across the entrance of the Craigmont tunnel.

Eight winter-banded bats have been reported during the summer months, as shown in Table 3. The most interesting of these is the female *M. subulatus leibii* at Northcote that called attention to the first colony known for this species, behind a sliding door (Hitchcock, 1955). *Eptesicus*, though the largest species studied, does not appear to travel far from summer to winter quarters, possibly because it can survive in buildings and exposed places unacceptable to other bats. One was reported at 16 miles, another at two miles. Beer (1955) has reported one that moved 61 miles. The summer-banded specimens recaptured during hibernation were all within five miles of the colony. *Myotis lucifugus*, which weighs half as much as *Eptesicus*, has been reported traveling 168 miles (Griffin, 1940). In the present study one was recaptured at 82 miles and another at 70.

One banded bat is known to have been picked up in the area by a finder who did not report it, and others can be assumed to have been, for most of the bands had the instructions for reporting well concealed on the inner surface. By using a larger band, number 2, with instructions exposed, Davis and I (MS *in press*)

TABLE 3.—Winter-banded bats reported during summer.

Place	Date	Species	Sex	Recaptured at	Date	Distance (mi.)
Craigmont	11/28/47	*M. lucifugus*	♀	Noble Bay, Ont.	4/15/51	70 SW
,,	11/27/53	,, ,,	♀	Belleville, Ont.	6/6/56	82 S
,,	4/9/58	,, ,,	♂	Combermere, Ont.	7/2/60	5 N
Tyendinaga	4/8/58	,, ,,	♂	Consecon, Ont.	9/3/58	25 SSW
Fourth Chute	12/22/49	*M. subulatus*	♀	Cobden, Ont.	9/21/53	12 NE
,, ,,	2/20/53	,, ,,	♀	Northcote, Ont.	7/6/53	10 E
,, ,,	1/6/43	*Eptesicus*	♂	Hyndford, Ont.	5/30/46	2 SE
St. Pierre	3/15/45	,,	♀	Aylmer, Que.	6/29/46	16 S

have had a marked increase in the percentage of bats reported in New England by casual finders. If such bands had been used throughout the present study, there might now be an answer to one of the questions that prompted the investigation, namely, "What is the migratory pattern of the cave bats in this part of Canada?" The handful noted in Table 3 is insufficient to provide a satisfactory answer.

Table 4 lists the oldest of each sex and species discovered during the investigation. The nineteen-year-old *Eptesicus* and the twelve-year-old *M. subulatus leibii* are the oldest of their species reported so far. The worth of observations on longevity depends on the span of years covered and the number

TABLE 4.—Longevity. The two oldest ages for each species and sex are listed.

Banded	Place	Species	Sex	Recaptured	Age
1/6/43	Fourth Chute	*Eptesicus*	♂	1/14/62	19
2/25/45	,, ,,	,,	♂	2/17/56	11
2/26/44	,, ,,	,,	♀	2/17/56	12
1/18/41	St. Pierre	,,	♀	12/13/46	6
11/27/53	Craigmont	*M. keenii*	♂	12/18/58	5 (2)
11/29/47	Fourth Chute	,, ,,	♂	2/28/53	5
11/25/39	St. Pierre	,, ,,	♂	12/19/42	3
1/4/47	Fourth Chute	,, ,,	♂	12/22/49	3
1/17/41	Tyendinaga	*M. lucifugus*	♂	2/24/61	20
2/26/45	Craigmont	,, ,,	♂	12/14/63	19
4/11/41	Tyendinaga	,, ,,	♀	2/24/61	20
2/26/45	Craigmont	,, ,,	♀	11/27/53	9 (2)
11/27/53	,,	,, ,,	♀	12/16/62	9 (2)
2/26/44	Fourth Chute	*M. subulatus*	♂	2/20/53	9
2/26/44	,, ,,	,, ,,	♂	2/24/50	6
2/26/44	,, ,,	,, ,,	♀	1/17/56	12
2/26/44	,, ,,	,, ,,	♀	12/22/49	6
4/4/42	St. Pierre	*Pipistrellus*	♂	2/7/48	6
4/3/42	Tyendinaga	,,	♂	4/11/43	1
2/24/50	Fourth Chute	,,	♀	2/20/53	3

Note: most of these bats can be assumed to have been born in June. Age in years at time of banding was not known.

of individuals observed. Banding of bats began in a serious way about thirty years ago. Since then not a few reports of longevity records have been published, only to be superseded within a few years. It would be unrealistic to suppose that the records noted above will not be superseded as larger numbers of bats are observed.

The nineteen-year-old *Eptesicus* was retaken at the cave nine times (Figure 1). On January 14, 1962, it was inadvertently killed, and is now in the museum collection of Carleton University, Ottawa. It might be noted that Christian (1953) postulated a maximum age of six or seven years for *Eptesicus*. His reasoning was based on wear of the upper canine teeth. Though these teeth on the nineteen-year-old specimen are badly worn, they appear to be still serviceable. Our studies suggest that *Eptesicus* normally dies at a much younger age, but five are known to have survived nine years, five 10 years, one 11 years, and one 12 years after being banded. Though Christian concedes that bats in the Ottawa region might survive longer than in Maryland, where he made his observations, our data suggest that his interpretation of age groups based on tooth wear was faulty.

The published records of longevity in the other species are as follows: *M. l. lucifugus*, 20.5 years, and *M. keenii septentrionalis*, 18.5 years (Hall *et al*, 1957); *Pipistrellus subflavus*, 10 years (Mohr, 1953).

It should be pointed out that these figures apply to exceptional bats — the Methuselahs of their species. The life expectancy, even of a bat that enters hibernation its first year, appears to be but a few years, as shown in Figure 1. The figure also shows that survival is better in males than females, except in *M. subulatus leibii*, where the two sexes show little difference.

Summer colonies of *M. lucifugus* and *Eptesicus* are known in the area. They are in attics or other confined spaces where the temperature climbs well above that prevailing on sunny days. They are composed almost exclusively of females and their young, and in them the bats remain active throughout the day. The crowding in such places provides ideal conditions for the multiplication and spreading of ectoparasites. Males of these species spend their days in cooler, less crowded surroundings, and in a less active state. These differences in environment and activity probably account for the better survival of males in these species. Similar conditions may influence the survival in the pipistrelle and *M. keenii*.

The fairly equal survival of the two sexes in *M. subulatus leibii* suggests that both occupy similar summer quarters. Unfortunately the one colony discovered was not permanent and no study of its composition was made. It was in a cooler location than typical colonies of little and big brown bats, and it was small. Colonies may not be usual in this species; Hall and Kelson (1959) state that the species is not colonial.

Weights of bats collected during hibernation are given in Table 5. No weighing of live bats was attempted in the field.

Sexual activity was noted in *M. keenii* at Fourth Chute. On December 18, 1958, a male attempted to copulate while still in the collecting cage, before being banded. On February 25, 1961, actual copulation was witnessed, and on December 19, 1961, attempted copulation was again seen.

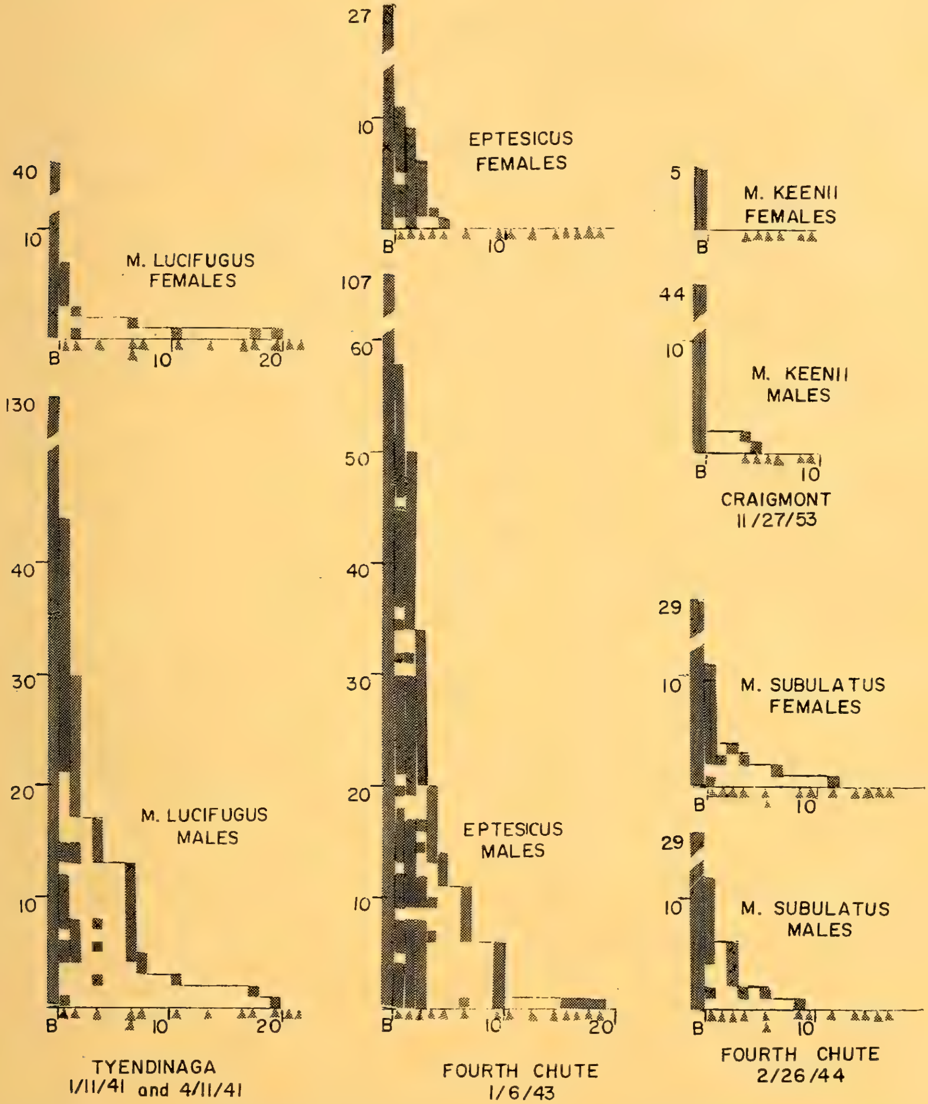

FIGURE 1. Survival of banded bats. (B: bats banded; solid blocks: bat present; arrow: colony searched for banded bats; abscissa: years after banding; ordinate: number of bats. History of each bat runs horizontally from banding column.)

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TABLE 5.—Weights of hibernating bats.

Species	Date	Sex	Weight (gms)	Mean Jan. Weight	Mean post-Jan. Weight
Eptesicus	1/20/43	♀	16.6		
,,	1/20/42	♀	16.5		
,,	1/27/42	♀	14.8		
,,	1/27/42	♀	15.7		
,,	2/3/41	♂	13.6		
,,	3/15/42	♂ juv.	11.4		
,,	3/2/40	♀	13.4		
,,	3/16/41	♂	11.8	15.9	12.6
M. keenii	1/6/43	♂	5.8		
,, ,,	1/6/43	♂	5.7		
,, ,,	1/18/41	♂	6.8		
,, ,,	4/4/42	♂	5.2	6.4	(5.2)
M. lucifugus	1/17/41	♂	8.5		
,, ,,	1/17/41	♂	7.1		
,, ,,	1/17/41	♂	6.3		
,, ,,	1/17/41	♀	8.0		
,, ,,	1/17/41	♀	7.4		
,, ,,	4/3/42	♂	6.7		
,, ,,	4/3/42	♂	6.6	7.5	6.7
M. subulatus	1/6/43	♂	4.9		
,, ,,	1/6/43	♀	5.4		
,, ,,	1/6/43	♀	5.0		
,, ,,	1/17/41	♀	4.7		
,, ,,	1/17/41	♂	5.5		
,, ,,	1/18/41	♀	4.6		
,, ,,	1/18/41	♀	4.6		
,, ,,	4/4/42	♀	4.7		
,, ,,	4/4/42	♀	4.7		
,, ,,	4/4/42	♂	4.1	5.0	4.4
Pipistrellus	1/6/43	♂	4.4		
,,	1/6/43	♂	5.9		
,,	1/17/41	♂	6.8		
,,	1/17/41	♂	6.1		
,,	1/17/41	♂	5.4		
,,	1/18/41	♂	6.1		
,,	1/18/41	♂	5.4		
,,	2/23/41	♂	5.3		
,,	2/23/41	♀	6.6		
,,	4/25/40	♂	5.9		
,,	4/25/40	♂ juv.	5.4	5.7	5.8

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MORTALITY OF DIVING DUCKS ON LAKE WINNIPEGOSIS THROUGH COMMERCIAL FISHING

James C. Bartonek
Department of Wildlife Management, University of Wisconsin
Madison 6, Wisconsin

Introduction

Redhead (*Aythya americana*) and Canvasback (*A. valisineria*) populations in North America have been so precariously low that both the Canadian and United States governments afforded these species complete protection during the 1962 and 1963 waterfowl hunting seasons. These two species, along with several other species of diving ducks, have received varying degrees of special protection during the past 30 years. All of such regulations were designed to reduce losses from hunting. Although much is known regarding waterfowl losses through hunting, little is known regarding the types and magnitudes of nonhunting mortalities. This paper appraises the mortality of diving ducks and other birds in nets used for commercial fishing in summer on Lake Winnipegosis, and it makes recommendations for waterfowl management based upon this study and long-term information of waterfowl concentrations in the area.

Accidental and intentional netting of waterfowl has long been known to exist in North America. One of the earliest accounts of netting waterfowl is found in the Relation of the mission of St. Francois Xavier (Anonymous, 1899, p. 121). In the Relation of 1671-72, on Green Bay, Wisconsin, the following observation was made: "Of this practice [netting ducks] the Savages are the inventor; for perceiving that Ducks, Teal, and other Birds of that kind dive into the water in quest of the grains of wild rice [which are] to be found there toward the Autumn season, they stretch nets for them with such skill that, without counting the fish, they sometimes catch in one night as many as a hundred wild fowl." During later years market hunters would set gill-nets for Canvasback (Grinnell, *et al.*, 1918; Phillips, 1925). Ellarson (1956) reviewed much of the literature on diving duck mortality through commercial fishing and reported his findings on 9,215 ducks caught in nets on Lake Michigan. William F. Nichols (*in. litt.*) reported 1,904 and 2,320 ducks (mostly divers) being caught in trammel-nets on the Mississippi flyway during the winter and spring of 1960-61 and 1961-62, respectively. My review of the literature has not revealed any reports of diving duck losses through netting during the summer months.

Observations

I first became aware of the net mortality among diving ducks on Lake Winnipegosis on August 6, 1961, when George W. Cornwell and I were crossing Long Island (Waterhen) Bay (Figure 1). We found a dead Redhead drifting and entangled in a fragment of gill-net. Because several floats were still attached, I assumed that the net had been torn loose during a storm. In 1962, for the purpose of a waterfowl food-habits study, I obtained 14 diving

ducks that were caught in a single haul of a net sometime late in August by Mike Magnusson, Bev S. Johnson, and Orville Belinducke, all of Winnipegosis. This group of flightless birds consisted of 13 Redheads and one Common Goldeneye (*Bucephala clangula*).

During the summer of 1963, I asked the managers of the only three fish-processing stations operating on the southern half of Lake Winnipegosis to have their fishermen cut off and save one wing from each bird caught in their nets. Only 128 wings were collected in this manner; but through casual observations during two visits to the processing stations, 11 additional birds were observed either aboard the boats or being carried home by fishermen. The last collection of wings was made during the end of the sixth week of the nine-week fishing season which opened on July 23.

From 1961 to 1963, observations were made on 154 birds, representing eight species, that were caught in gill-nets on Lake Winnipegosis (Table 1).

TABLE 1.—Observations on 154 birds caught in gill-nets by commercial fishermen on Lake Winnipegosis

Species	Number of Birds		
	Adult	Juvenile	Total
Redhead	63	2	65
Western Grebe	28	17	45
Horned Grebe	11	3	14
Common Loon	10	—	10
Red-necked Grebe	9	—	9
Canvasback	3	3	6
Common Goldeneye	3	1	4
American Widgeon	—	1	1

The species netted included: Redhead, Canvasback, Common Goldeneye, American Widgeon (*Anas americana*), Western Grebe (*Aechmophorus occidentalis*), Red-necked Grebe (*Podiceps grisegena*), Horned Grebe (*P. auritus*), and Common Loon (*Gavia immer*). Anseriformes accounted for 49 per cent of these netted birds; the Podicipediformes and Gaviiformes, 44 and 6 per cent, respectively. The Redhead (42 per cent) and the Western Grebe (29 per cent) occurred most frequently.

Seventeen of the netted Western Grebes and three of the Horned Grebes were juveniles. There appeared to be no juvenile mortality in the Red-necked Grebe and Common Loon.

Only seven out of 76 waterfowl netted were juvenile birds; and only two of these were Redheads. Sex ratios among the adult waterfowl were as follows: Redhead, 51 ♂♂: 12 ♀♀; Canvasback, 2 ♂♂: 1 ♀♀; Common Goldeneye, 0 ♂♂: 3 ♀♀. All of the adult waterfowl netted, except for a female Canvasback with a brood of three ducklings, were in the flightless stage of their molt.

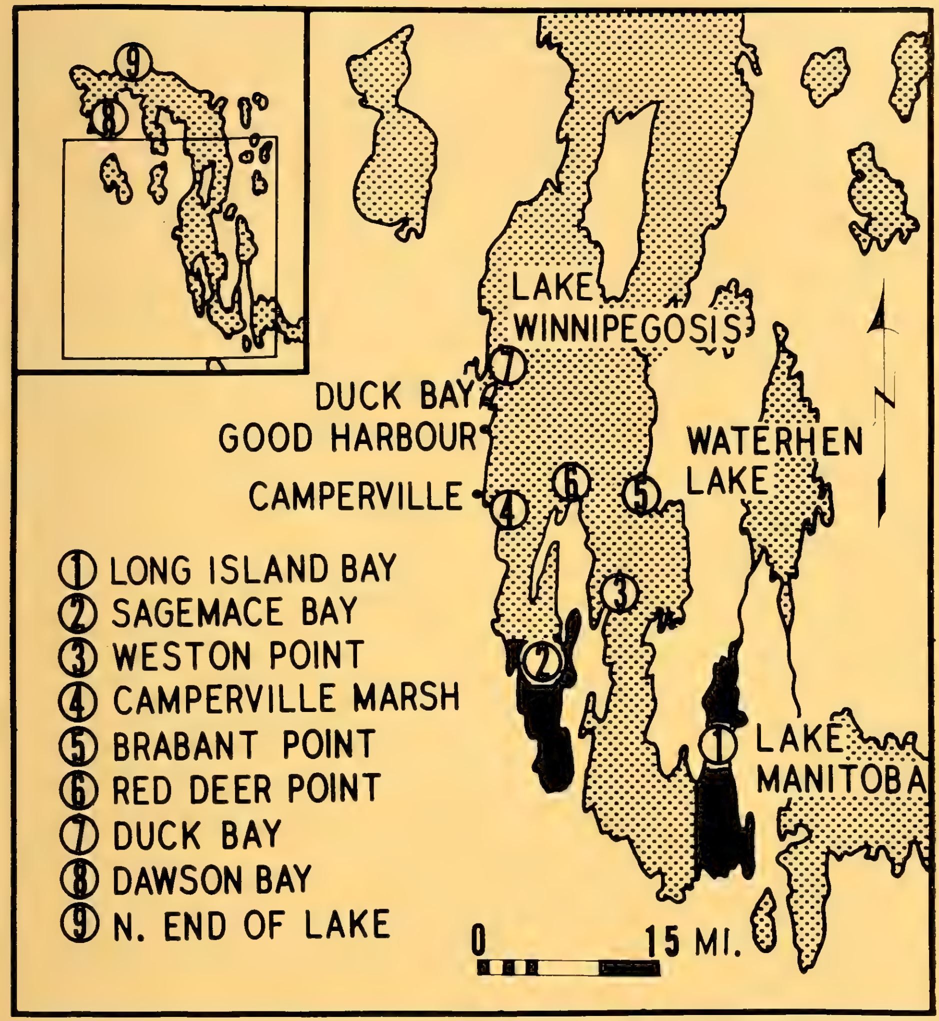

FIGURE 1. A map of southern Lake Winnipegosis showing locations of fish-processing stations, areas included in Ducks Unlimited aerial surveys (numbered circles), and locations of high summertime diving duck concentrations (in solid black).

The magnitude of diving bird losses in the southern half of Lake Winnipegosis attributable to commercial fishing can be estimated by an extrapolation of information obtained by questioning the local fishermen. In personal interviews, most fishermen said that from 15 to 30 ducks and 100 "divers" (grebes) and loons were caught per boat during a season. Of the five fish-processing stations on Lake Winnipegosis, two are located at Dawson Bay in the northern half, and the other three are in the southern half. During the 1963 season, 30 boats were operating out of the southern processing stations

located at Good Harbour, Duck Bay, and Camperville (Figure 1). If the fishermen's estimates were correct then approximately 450 to 900 ducks and 3,000 grebes and loons are netted annually by the southern group of fishermen. These estimates may be low, because one fisherman cited an example when three boats caught approximately 120 Redheads in a single haul of their nets. Another fisherman reported catching up to 50 Redheads a day for nearly two weeks; this period apparently coincided with the peak period of molting for Redheads.

Discussion

The 1963 commercial fishing season on Lake Winnipegosis opened on July 23, and ran for nine consecutive weeks. Each license holder was permitted 20,000 pounds of yellow pike-perch (*Stizostedion vitreum*) plus an unlimited poundage of any other species of fish. All fishermen used gill-nets in the relatively shallow (20 foot mean depth) waters of Lake Winnipegosis.

Adult male Redheads were more frequently netted than any other group of waterfowl. Except possibly for botulism outbreaks on molting lakes, this relatively large loss to the adult male diving-duck population represents a unique situation. Generally, the only summertime mortality reported for waterfowl is that of nesting females or juvenile birds.

The large netting of Redheads (87 per cent) reflects their high concentration in areas used for fishing. On August 5, 1961 and August 24, 1962, respectively, I counted 7,530 and 2,002 diving ducks on aerial surveys over southern Lake Winnipegosis. On both occasions the Redheads were estimated to comprise 99 per cent of those counted. At approximately three-week intervals from May 23, 1963 to September 3, 1963, I made aerial counts of diving ducks over the same portions of the lake covered in the two previous years (Table 2). These counts were supplemented by a flight made by E. F.

TABLE 2.—Diving ducks on southern Lake Winnipegosis as observed during aerial surveys conducted in 1963

Observations on Waterfowl	Date of Aerial Survey						
	22 May	13 Jun	6 Jul	29 Jul	13 Aug	3 Sep	19 Sep*
No. diving ducks	1,972	1,027	14,111	26,453	15,260	1,076	10,005*
Percent Redhead	19	12	99	99	99	48	
Percent Canvasback	23	58	1	1	1	52	
Percent other divers	58	30	—	—	—	—	

*Aerial survey made by E. F. Bossenmaier, H. A. Hochbaum, and Peter Ward; this number represents only Canvasback and no other species of waterfowl.

Bossenmaier, H. A. Hochbaum, and Peter Ward on September 19, 1963, during which only Canvasback were recorded (*in litt.*). These observations on southern Lake Winnipegosis indicated a build-up in Redhead numbers during the molting season in July and August and a subsequent decline during September.

The numbers of Canvasbacks remained relatively low throughout the summer, but they increased noticeably during September. The nine-week fishing season spanned both periods when peak numbers of Redhead and Canvasback were found. If wing collections had been made after the first week in September it is probable that more Canvasback would have been found among the birds netted later in the season.

In spite of relatively large numbers of dabbling ducks and coots found in the same waters with the diving ducks, only one dabbling duck, a juvenile widgeon, was found in the nets. This can undoubtedly be explained by differences in feeding habits of the two groups of birds. Eleven of the adult Redheads were found to be feeding almost exclusively upon the winter buds of a pondweed (*Potamogeton* sp.); some pondweed and bulrush (*Scirpus* sp.) seeds, along with a few snails (Gastropoda), were found in smaller quantities. An adult female Canvasback, with what appeared to be her brood of three ducklings, had been feeding mainly upon mayfly (Ephemeroptera) nymphs and midge (Chironomidae) larvae. Apparently the diets of Redhead and Canvasback found on the lake changes from summer to fall. Of 17 diving ducks collected on the lake in mid-October, nine Redheads had fed exclusively upon muskgrass (*Chara* sp.); while eight Canvasbacks had fed primarily upon pondweed tubers and seeds.

Ducks Unlimited gave me data from mid-August to early-September aerial surveys of waterfowl concentrations during 1938-58. These data present subjective appraisals of the combined numbers of Redhead and Canvasback for each of eight locations designated on the lake as shown in Figure 1 (Table 3).

TABLE 3.—Number of years in which various sizes of Redhead and Canvasback concentrations have been observed on parts of Lake Winnipegosis during Ducks Unlimited's aerial surveys conducted in late August and early September, 1938-58

Location	Number of Years			
	Observations Taken	Concentrations Observed		
		Large	Medium	Small
Long Island Bay	13	2	3	3
Sagemace Bay	13	3	2	—
Weston Point	1	—	1	—
Camperville Marsh	2	—	1	—
Brabant Point	1	1	—	—
Red Deer Point	3	—	1	—
Duck Bay	12	1	1	—
North end of Lake Winnipegosis	11	—	1	1

They suggest that Long Island Bay and the southern half of Sagemace Bay are frequent sites of diving duck concentrations; my three years' experience confirm this. Long Island Bay appears to have large concentrations earlier in the summer than Sagemace Bay.

Of those birds caught in nets, probably only the loon goes unutilized. From interviews with fishermen and personal observations, I am of the opinion

that all ducks, both adult and juvenile, and most grebes are used for food either by the fishermen or other residents of the fishing villages.

Commercial fishing is apparently the main source of income in the vicinity of Duck Bay, Good Harbour, and Camperville; and it is, therefore, vital to the livelihood of these people. Considering the economic importance of fishing and that, by and large, only the adult male segment of the waterfowl population is affected, I would suggest that normally no prohibitive regulation should be imposed upon the fishermen. However, should circumstances of reduced continental populations coupled with the increased local concentrations of diving birds warrant additional protection the lower half of Sagemace Bay and all of Long Island Bay might be closed to fishing. These areas are delineated in black on Figure 1. The long-term aerial surveys of the lake indicate that large concentrations of diving ducks are infrequently found other than in these two locations; therefore, lake-wide fishing restrictions are not warranted.

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I wish to acknowledge the financial support received from the North American Wildlife Foundation, operating through the Delta Waterfowl Research Station, and the University of Wisconsin during this investigation. I also wish to thank the following people: H. Albert Hochbaum, for his suggestions and encouragement of the study; Peter Ward and Nan Mulder, for their assistance in sexing and aging wings taken from netted birds; William G. Leitch, for making available aerial survey data of Ducks Unlimited; the Manitoba Wildlife Branch and Royal Canadian Mounted Police, for providing several flights over Lake Winnipegosis.

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A BIRD CENSUS IN RED PINE PLANTATIONS AND MIXED STANDS IN KIRKWOOD TOWNSHIP, ONTARIO*

J. E. MacDonald
Forest Insect Laboratory, Sault Ste. Marie, Ontario

Introduction

A bird census was carried out in 1962 in Kirkwood Township, about 50 miles east of Sault Ste. Marie, Algoma District, Ontario, as an integral part of an ecological study of insects in red pine plantations. The primary objective was to compare the species and numbers of birds nesting in pure red pine plantations and natural mixed stands, and to study the changes in bird populations as red pine stands mature and the environment changes from open field to closed forest.

Sample Plots and Methods

Plots were established in three types of habitat. These were characterized by semi-open red pine plantations (12 acres), closed red pine plantations (12 acres), and a well-stocked natural mixed stand containing white pine, white spruce, largetooth aspen, trembling aspen, white birch, and red maple (10 acres). The plots were divided into half-acre quadrats to facilitate mapping the location of birds. Ground cover and undergrowth were sparse in the closed stands, moderately dense in the semi-open stands, and abundant in the mixed stand (Figure 1). The physical and historical background of the area and the soil and vegetational characteristics of the red pine stands were described by Martin (1961).

The census was based on counts of singing male birds during the breeding season. This method has been used extensively in both North America and Europe. Cooke (1927) stated "a convenient way of taking a bird census is to count the singing males very early in the morning. At this time every male bird is usually in full song near the nest site; and after migration is over, each one may safely be considered to represent a breeding pair."

During each observation period, the plots were traversed along parallel lines 150 feet apart at a walking rate of approximately 0.5 miles per hour. In most instances singing males could be sighted and their locations plotted accurately in relation to the corner stakes of the half-acre quadrats. Concealed singers were located from the intersection of song bearings from two reference points. Each day's record was kept on a separate map. When a male bird was recorded repeatedly in a limited area it was assumed it had claimed a territory, and represented a nesting pair. Since observations were made on 12 mornings during the breeding season, territories of individual pairs were established with considerable assurance, and the possibility of duplication minimized. By the same token, the chance of including transients in the census was lessened.

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*Contribution No. 1068, Forest Entomology and Pathology Branch, Department of Forestry, Ottawa, Canada.

POPULATIONS

Eighteen species of birds nested in the mixed stand, six in the semi-open red pine stands and one species in the closed red pine stands. The species and numbers of pairs of birds in the three habitats are listed in Table 1 and summarized in terms of pairs per 10 acres in Table 2.

TABLE 1. —Number of pairs of birds nesting in plots in a natural mixed stand and in semi-open and closed red pine stands in 1962

Species	Number of pairs*	
	Mixed stand	Semi-open stand
Rusty Blackbird, *Euphagus carolinus*	2	0
Black-capped Chickadee, *Parus atricapillus*	1	0
Northern Flicker, *Colaptes auratus*	1	0
Slate-colored Junco, *Junco hyemalis*	1	4
Blue Jay, *Cyanocitta cristata*	1	0
Ovenbird, *Seiurus aurocapillus*	9	0
Robin, *Turdus migratorius*	2	2
Chipping Sparrow, *Spizella passerina*	0	3
Vesper Sparrow, *Pooecetes gramineus*	0	4
White-throated Sparrow, *Zonotrichia albicollis*	2	0
Brown Thrasher, *Toxostroma rufum*	1	1
Hermit Thrush, *Hylocichla guttata*	3	0
Red-eyed Vireo, *Vireo olivaceus*	2	0
Canada Warbler, *Wilsonia canadensis*	1	0
Chestnut-sided Warbler, *Dendroica pensylvanica*	3	0
Magnolia Warbler, *Dendroica magnolia*	1	0
Mourning Warbler, *Oporornis philadelphia*	1	0
Myrtle Warbler, *Dendroica coronata*	0	0
Nashville Warbler, *Vermivora ruficapilla*	3	0
Cedar Waxwing, *Bombycilla cedrorum*	0	1
Northern Three-toed Woodpecker, *Picoides americanus*	1	0
Hairy Woodpecker, *Dendrocopos villosus*	1	0

*Only one pair of birds (Myrtle Warblers) nested in the closed red pine stand in 1962.

TABLE 2. —Number of species and pairs of birds in three types of habitat in Kirkwood Township in 1962

	Area in acres	Number of species	Number of pairs per ten acres
Mixed stand	10	18	36
Semi-open red pine stand	12	6	15
Closed red pine stand	12	1	1

DISCUSSION

Allard (1930) in a study of the first morning song of birds stated that temperatures had little effect on singing activity, and Wright (1912) did not con-

Figure 1. Habitat types selected for bird census in Kirkwood Township, Ontario. Top, well-stocked mixed stand; Middle, semi-open, 12-year old red pine plantation; Bottom, closed red pine stand with sparse ground cover.

sider that the effect of cloudy weather was significant. During the Kirkwood census electrical storms accompanied by heavy rains caused a brief cessation of singing during two observation periods, but being of short duration, they had little effect on the final results of the census.

The number of observation periods required to obtain a reliable census has been discussed by various authors. Cooke (1927) suggested that observations be made at least twice during the breeding season. Palmgren (1930) found that four observations gave a high degree of accuracy, and Kendeigh (1944) recommended five observations to attain the accuracy obtained by Palmgren. Since large numbers of species were involved in the Kirkwood plots, and their breeding seasons differed, the census was derived from 12 observations between May 4 and July 6. However, results showed that the same accuracy would have been obtained from six observations taken at four- to five-day intervals between May 25 and June 29.

There was a marked difference in the numbers of species and pairs of birds in the three habitats; the largest numbers occurring in the mixed stand (36 pairs), fewer in the semi-open red pine stands (15 pairs), and only one pair in the closed stand. Young red pine stands provide a suitable habitat for birds that normally nest in open and semi-open areas. However, when these stands close and ground cover becomes sparse, fewer nesting sites are available. Furthermore, insect fauna, forming a large part of the diet of finches and other species that nested in the young red pine plantations, was more abundant than in the closed stands. Martin (1961) reports that both diurnal ground surface insects and foliage insects were much more abundant in the semi-open stands than in the closed stands. Clearly, as the habitat becomes more uniform in red pine stands, both nesting sites and prey for insectivorous species are reduced, and result in a decline in bird populations.

Acknowledgements

The author wishes to thank J. L. Martin for his helpful suggestions during the course of the census and the preparation of the data. Special thanks is also due to R. Dennison for his assistance in identifying warbler songs in the field.

Summary

The species and numbers of birds nesting in red pine *Pinus resinosa* plantations in Kirkwood Township, Ontario, was small compared with populations in adjacent mixed stands. Finches were most numerous in the red pine stands, with Vesper Sparrows, Chipping Sparrows, and Slate-colored Juncos predominating. Few birds nested in red pine stands with closed canopies and sparse ground cover.

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STUDIES OF THE BYRON BOG IN SOUTHWESTERN ONTARIO

XX. INSECTS AND MILLIPEDS ASSOCIATED WITH FUNGI

William W. Judd
Department of Zoology, University of Western Ontario, London, Ontario

In the description of the Byron Bog (Judd, 1957a) it was pointed out that there are three zones in the area. They are designated as A, B and C on the map accompanying the description and their outer limits are shown on the map. Zone A is the central floating bog based on a mat of *Sphagnum* moss and covered almost completely by Leatherleaf, *Chamaedaphne calyculata.* Zone B is a low, wooded region, damp or flooded, with hardwood trees and shrubs at its outer limits and Black spruce and Larch at its inner limits. Zone C consists of wooded slopes occupied by deciduous trees and shrubs.

On September 16, 1962 a collection of fungi was made in the bog and was reported on by Judd (1963). Most of the specimens were found in Zone B. On October 7, 1963 another collection was made and the insects and millipeds found on the fungi were collected from them. The autumn of 1963 followed an exceptionally dry summer and consequently Zone B, which is ordinarily damp, was in very dry condition. Only one fungus, some dry *Pholiota alnicola*, was found on the side of a stump in Zone B. All the other fungi were found on the border between Zone A and Zone B along the line a – a shown on the map (Judd, 1957a). In this area the fungi were growing in damp *Sphagnum* in the shade of Larch, Black spruce and High-bush blueberry, *Vaccinium atrococcum.*

Altogether, twenty collections of fungi were made, each comprising a single plant or a few plants growing closely together. They were dried and

sent for identification to Dr. J. W. Groves, Head of the Mycology Section, Plant Research Institute, Department of Agriculture, Ottawa. Miss L. K. Weresub identified *Thelephora* and Dr. Groves identified all other specimens The specimens are deposited in the Mycology Section. When the fungi were being collected they were shaken over a white porcelain tray into which insects and millipeds fell from the fungi; or the insects and millipeds were sucked from the fungi with an aspirator or picked from them with forceps. The following taxonomists identified the specimens (USDA refers to Agricultural Research Service, United States Department of Agriculture): B. D. Burks, USDA (Eulophidae), N. B. Causey, Louisiana State University, Baton Rouge, Louisiana (Diplopoda), K. Christiansen, Grinnell College, Grinnell, Iowa (Collembola), J. M. Kingsolver, USDA (Eucinetidae), C. F. W. Muesebeck, USDA (Braconidae), C. W. Sabrosky, USDA (Sphaeroceridae), A. Stone, USDA (Mycetophilidae). No taxonomist was available for identification of Staphylinidae. All specimens are retained in the collection of the Department of Zoology, University of Western Ontario except those noted as "kept" in the institutions where they were identified. Specimens from the twenty collections are noted separately in the following account.

AGARICAEAE

Lactarius rufus (Scop. ex Fr.) Fr.
1. Hymenoptera, Eulophidae: 3 ♀ ♀ (1 kept) *Achrysocharella acuminaticornis* Girault
2. Coleoptera, Staphylinidae: 2 beetles
3. Coleoptera, Staphylinidae: 4 beetles
4. Diplopoda, Polyzoniidae: 1 (kept) *Polyzonium bivirgatum* (Wood)
5. Collembola, Sminthuridae: 2 (kept) *Ptenothrix marmorata* (Packard)
   Hymenoptera, Eulophidae: ♀ ♀ *Achrysocharella acuminaticornis* Girault
6. Coleoptera, Eucinetidae: 50 (20 kept) *Eucinetus punctulatus* LeC.
7. Coleoptera, Staphylinidae: 4 beetles
8. Diplopoda, Polyzoniidae: 2 (kept) *Polyzonium bivirgatum* (Wood)
   Collembola, Sminthuridae: 1 (kept) *Ptenothrix marmorata* (Packard)
   Coleoptera, Staphylinidae: 1 beetle
   Hymenoptera, Eulophidae: 4 ♀ ♀ *Achrysocharella acuminaticornis* Girault
9. Coleoptera, Staphylinidae: 1 beetle
10. Diplopoda, Polyzoniidae: 1 (kept) *Polyzonium bivirgatum* (Wood)
11. Collembola, Sminthuridae: 1 (kept) *Ptenothrix marmorata* (Packard)
    Coleoptera, Staphylinidae: 1 beetle
12. Collembola, Entomobryidae: 2 (kept) *Tomocerus flavescens* (Tullberg)
    Collembola, Sminthuridae: 3 (kept) *Ptenothrix marmorata* (Packard)
    Coleoptera, Staphylinidae: 1 beetle

Paxillus involutus Fr.
13. Coleoptera, Eucinetidae: 1 *Eucinetus punctulatus* LeC.

Pholiota alnicola (Fr.) Singer
14. Coleoptera, Staphylinidae: 6 beetles
Boletinus cavipes (Opat.) Kalchbr.

BOLETACEAE

Boletinus cavipes (Opat.) Kalchbr.
15. Diptera, Mycetophilidae: 3 *Bolitophila* sp.

Boletinus paluster Peck
16. Collembola, Sminthuridae: 1 (kept) *Ptenothrix marmorata* (Packard)

Suillus grevillei (Kl.) Singer
17. Collembola, Entomobryidae: 1 (kept) *Tomocerus flavescens* (Tullberg)
    Coleoptera, Staphylinidae: 1 beetle
18. Coleoptera, Staphylinidae: 1 beetle

THELEPHORACEAE

Thelephora terrestris (Ehrh.) Fr.
19. Diptera, Sphaeroceridae: 1 *Copromyza atra* (Mg.)
    Hymenoptera, Braconidae: 1 *Phaenocarpa* sp.
20. Unidentified fungus (eaten by fly larvae when drying)
    Coleoptera, Staphylinidae: 1 beetle.

DISCUSSION OF COLLECTIONS

The fungus most commonly collected was *Lactarius rufus*, a species recorded by Groves (1962) as being found in coniferous woods and spruce bogs. The other fungi collected are in genera recorded from woods and damp areas (Groves, 1962; Krieger, 1935). *Paxillus involutus* is recorded as being found in spruce forests (Krieger, 1935), *Boletinus cavipes* and *Suillus grevillei* are reported as being associated with larch (Groves, 1962; Krieger, 1935) and *Thelephora terrestris* is a fungus which strangles young seedlings of conifers.

The numbers of collections of fungi from which the several taxonomic groups were collected, in order of decreasing numbers, was as follows: Coleoptera-13, Collembola-6, Hymenoptera-4, Diplopoda-3, Diptera-2. This distribution is closely similar to the distributions found by Judd (1957b) in Ontario and by Weiss (1922) in New Jersey, except that Weiss collected no Hymenoptera. In all instances the Staphylinidae predominated.

DIPLOPODA

The milliped, *Polyzonium bivirgatum* was found in three collections. It was previously collected by Judd (1957b) in stipes of fungi in the vicinity of London and was also found dead in a leaf of a pitcher-plant in the Byron Bog (Judd, 1959).

COLLEMBOLA

Two species of springtails were collected, *Tomocerus flavescens* and *Ptenothrix marmorata*, the latter more commonly than the former. Maynard (1951) reports of *T. flavescens* that it is very common on the ground and of *P. marmorata* that it is frequently found feeding on spores of gill fungi. Most of the specimens of *P. marmorata* were found on gills of *Lactarius rufus* and one was on *Boletinus paluster*.

COLEOPTERA

Rove beetles, Staphylinidae, predominated in the collections. Blatchley (1910), Judd (1957b) and Weiss (1922) all record that these beetles are common on fungi. The beetle *Eucinetus punctulatus* was found on two fungi. In one of these, *Lactarius rufus*, there were fifty beetles clustered among the gills and they hopped actively when disturbed. Blatchley (1910) records another species of *Eucinetus* collected from a fungus on oak stumps.

HYMENOPTERA

One braconid wasp, *Phaenocarpa* sp., and several eulophid wasps, *Achrysocharella acuminaticornis*, were collected. Muesebeck *et al.* (1951) record that these wasps are in taxonomic groups which include species parasitic on larvae of Diptera. It is thus likely that the wasps were parasites of such larvae in the fungi. Active larvae of Diptera were seen in some of the fungi collected including fungus No. 20 which was devoured by such larvae when being dried.

DIPTERA

The two flies collected, *Bolitophila* sp. and *Copromyza atra*, are in families which include species reported as associated with fungi (Curran, 1934). The three *Bolitophila* sp., were seated on the under side of the pileus among the gills on one *Boletinus cavipes.*

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EARLY NOTES ON WILDLIFE FROM NEW SAREPTA, ALBERTA

LLOYD B. KEITH
Department of Wildlife Management,
University of Wisconsin, Madison, Wisconsin

JAMES AND GEORGE HODGSON arrived at South Edmonton (then Strathcona), Alberta, on May 12, 1907, and two days later reached their brother Frank's homestead 25 miles southeast, near the present town of New Sarepta (Figure 1). Frank had emigrated from Yorkshire, England, two years earlier. The country was gently rolling and covered largely with fine stands of aspen (*Populus tremuloides*); innumerable small lakes, sloughs, and potholes dotted the landscape. The three brothers occupied a 12x14 foot log shack during 1907-08, and were mainly concerned with clearing land and constructing a larger dwelling to accommodate the rest of the family who were still in England. Their father, mother, three sisters and a younger brother arrived on May 23, 1908.

While the subsequent history of this family as homesteaders and farmers probably parallels that of many others of that day, an interesting and somewhat uncommon feature was their unfailing maintenance of a daily diary. This was begun when James and George sailed from England on April 26, 1907, and ended on June 5, 1942, when the farm was sold. Most entries deal with day-to-day events of rural life – work done, livestock records, crop yields, births, deaths, weather, etc. Here also, especially during the early years, were kept complete trapping and hunting records, and observations on natural history. These latter records and notes are the basis for the present paper, which is submitted primarily as an historical report.

During 1907-12, all game taken by the family was listed in the diary (Table 1); thereafter, as farming activities increased, details of hunting and trapping success became more and more sketchy. For at least 20 years, however, the trapping of muskrats (*Ondatra zibethicus*) and weasels (*Mustela* spp.) continued to provide an important supplement to the Hodgson income.

MAMMAL NOTES

DEER. The total number of deer sightings mentioned in the diary, 14 during 1907-42, attests to their scarcity. Although mule deer (*Odocoileus hemionus*) predominated, an interesting early observation of white-tailed deer (*O. virginianus*) occurred on February 13, 1913, when three "white-flag deer" were seen seven miles west of New Sarepta on the trail to Leduc. Seton's (1909, p. 75) range map showed white-tails occurring about as far north as Edmonton, but Lawton (1908) reported them practically extinct throughout the province. Writing in the late 1940's, Soper (1951a) considered this species a recent arrival in central Saskatchewan and southern Alberta, i.e. "Within the last decade or two."

BLACK BEAR (*Ursus americanus*). A bear was shot at and frightened away from Hodgsons' milk house on May 12, 1910; it was likely the same animal that was killed two days later in a neighbour's (Bankonie's) hog pen. Another was shot by Frank Hodgson at

TABLE 1.—Mammals and birds trapped and shot on the Hodgson Homestead, New Sarepta, Alberta

Species or Family	Numbers Taken (May through following April)					
	1907–08	1908–09	1909–10	1910–11	1911–12	Total
MAMMALS						
Muskrat (*Ondatra zibethicus*)	10	93	284	104	97	588
Weasels (*Mustela* spp.)	21	39	41	26	9	136
Snowshoe hare (*Lepus americanus*)	12	22	24	53	10	121
Red squirrel (*Tamiasciurus hudsonicus*)	1	1		5		7
Striped skunk (*Mephitis mephitis*)		3	1	2		6
Flying squirrel (*Glaucomys sabrinus*)	2	2				4
Chipmunk (*Eutamias minimus*)		1		1		2
Coyote (*Canis latrans*)	1					1
BIRDS						
Ducks (Anatinae)	117	147	123	34	43	464
Ruffed Grouse (*Bonasa umbellus*)	4	10	26	79	21	140
Sharp-tailed Grouse (*Pedioecetes phasianellus*)			9	1	8	18
Grebes (Colymbidae)		3	3	3		9
Hawks (Accipitrinae and Buteoninae)	5	3	1			9
Owls (Strigidae)	1	2	2	3		8
Shorebirds (Charadriidae and Scolopacidae)	4	2				6
Bittern (*Botaurus lentiginosus*)				1		1
Coot (*Fulica americana*)		1				1
Crow (*Corvus brachyrhynchos*)		1				1
Canada Jay (*Perisoreus canadensis*)		1				1
Totals	178	331	514	312	188	1,523

Beaumont on August 5, 1911. Soper (1951b) indicated that black bears had disappeared from this general area before 1920.

LYNX (*Lynx canadensis*). The first lynx track was encountered on Section 8 (Figure 1) during the winter of 1913-14, and on December 11, 1914, a second was seen at the Heinz homestead, 5 miles south and 1.5 miles east of Hodgsons'. Two lynx were trapped on Section 17 during December 27-28, 1915, and others were taken at Girsch's on November 15, 1916, and at Hodgsons' on January 23 and December 2, 1917. The appearance of lynx during 1915-17 followed a decline in snowshoe hare (*Lepus americanus*) populations (Keith, 1963), and probably reflected a general population movement in response to food scarcity. This same phenomenon was witnessed in the Prairie Provinces during 1962 and 1963. No further reference is made to lynx over the ensuing 25-year span of the diary, thereby corroborating de Vos and Matel's (1952) evidence that the lynx had vanished from this section of its former geographic range.

SNOWSHOE HARE (*Lepus americanus*). In winter, "rabbits" were snared, or shot with a .22 rifle; while in summer many were caught in a 4.5 x 2.5 foot pit, about 3 feet deep. The pit was roofed with small saplings, and greenfeed (oats) was spread on top as bait.

The demand for rabbit pelts was sporadic, but over the years a few were sold. An entry on December 22, 1926 states that skins were bringing 12.5 cents: another dated December 21, 1929 reports two sold for 5 cents each.

Rabbits were common table fare until the mid-1920's when large "blisters," which were undoubtedly encysted larvae of the tapeworms *Multiceps* spp., were first noticed.

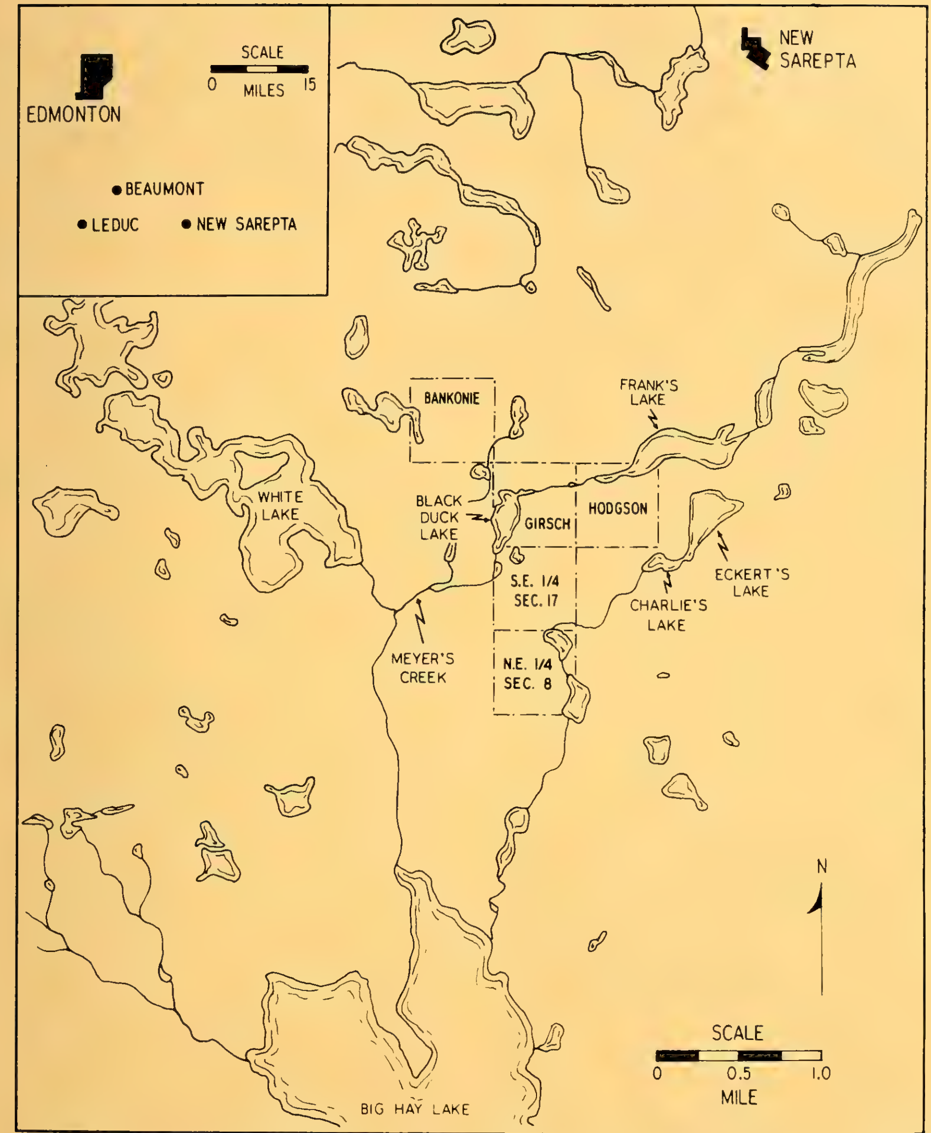

FIGURE 1. Map showing locations mentioned in text, and the names given by the Hodgson family to several small lakes in the vicinity of their homestead.

Other Albertans have also mentioned to me that rabbits became "diseased" around this time—blisters and lumps allegedly being symptomatic. The notion that rabbits carry some mysterious disease has since become deeply rooted, and they are now seldom eaten in western Canada. *Multiceps* was surely present before the 1920's, but its seemingly conspicuous appearance at that time is noteworthy. I have evidence, to be published elsewhere, that the incidence of *Multiceps* among hares may indeed vary greatly in the same region during different peak years.

A litter of young snowshoes was found on April 23, 1932. This is an early date for central Alberta, first litters usually being born during the first three weeks of May (Keith, unpublished).

JACK RABBIT (*Lepus townsendii*). Jack rabbits were not initially found in the New Sarepta district, the first noted by James Hodgson was in a meadow at the north end of Big Hay Lake (Figure 1) on September 4, 1922. According to Hodgson (*in litt.*) they subsequently became very plentiful for a number of years, then declined and persisted at relatively low levels.

RICHARDSON GROUND-SQUIRREL (*Citellus richardsoni*). An entirely white specimen was either shot or trapped on June 7, 1931; it had the typical pink eyes of an albino.

BADGER (*Taxidea taxus*). The first badger was seen on Section 17 (Figure 1) on August 5, 1915.

BIRD NOTES

WATERFOWL. Both dabbling and diving ducks abounded on the many sloughs and potholes in the district, and during the early years constituted a welcome addition to the family larder (Table 1). The sharp drop in numbers taken between 1909-10 and 1910-11 probably reflects the abandonment of "boom" trapping as the chief means of securing ducks for the table.

James Hodgson (*in litt.*) described the boom as follows: It was 8 feet long and made from three spruce slabs, each about 8 inches wide. The edges of the outer two, flat-side down, were nailed to those of the middle slab which was flat-side up, thus making a trough approximately 6 inches wide down the middle of the boom. Three unbaited No. 1 steel traps were set well apart along the trough, the ends of the trap chains being nailed so that the traps could swing free and drown anything which attempted to leave after being caught. The boom was anchored just off shore and checked daily. It undoubtedly offered an attractive loafing or resting place for waterbirds and muskrats, and Hodgson remarked that it seldom failed to yield something. On one ocasion he found a muskrat, a duck, and a great blue heron (*Ardea herodias*)—all drowned.

The annual return of ducks in spring was a noteworthy event, and there was always competition to see who would bag the first Mallard (*Anas platyrhynchos*). The diary records the first spring sighting of ducks (Table 2) during 22 years. While the species was not indicated, these first arrivals were almost certainly Mallards and Pintails (*Anas acuta*). The earliest reported arrival date was March 14 in 1914, and the latest was April 19 in 1940; the mean date was April 7, about 10 days later than that for crows (*Corvus brachyrhynchos*).

A number of years elapsed after the Hodgsons arrived at New Sarepta before ducks began feeding in grain fields, i.e. "stubbling." There is no diary record of this event, but James Hodgson (*in litt.*) states that the first he remembers were Mallards in a field of hull-less oats near Big Hay Lake during the fall of 1920. Stubble shooting is first mentioned in a diary entry of September 14, 1921.

RUFFED GROUSE (*Bonasa umbellus*). Frequent comments in the diary leave no doubt that "bush partridges" were exceedingly abundant in some years and scarce in others, a situation undoubtedly linked to their cyclic fluctuations:

- November 22, 1914: over 100 partridges bagged by two hunters in 5 days
- November 9, 1915: 8 partridges bagged by two hunters in 4 days
- October 20, 1921: 65 partridges and 16 chickens (Sharp-tailed Grouse, *Pedioecetes phasianellus*) taken by two hunters in 3 days
- October 17, 1924: 50 partridges and 4 chickens shot by one hunter in 3 days
- October 5, 1929: no partridges and 2 chickens bagged by two hunters in 5 days

Ruffed Grouse were at times a staple part of the homestead diet. When ammunition was in short supply, they were treed with a dog and snared using a wire noose on a long stick. Birds on the lowest limbs at evening roosts were shot or snared first so as not to disturb those higher up. Once when there was no lead shot for hand-loading shells, wheat was substituted, but proved ineffective —scarcely ruffling a feather at 20 feet.

A nest containing seven eggs was found on May 4, 1913.

TABLE 2.—Spring arrival dates of Ducks and Crows at New Sarepta, Alberta

Year	Ducks	Crows	Year	Ducks	Crows
1908	April 14		1927	April 13	
1909	April 8		1928		March 28
1910	March 28		1929	April 17	March 26
1912	April 3		1930	March 28	
1913	April 5	April 5	1931	March 30	March 30
1914	March 14	March 16	1932	April 3	April 2
1916	April 6		1933		March 28
1919		April 1	1934	April 5	March 30
1921	April 11	March 28	1935		March 24
1923	April 11		1936	April 16	March 23
1924	April 11		1937	April 8	April 3
1925	April 3	March 27	1938	April 12	
1926	April 11		1940	April 19	

Mean arrival dates: Ducks—April 7 (22 years)
Crows—March 28 (13 years)

SHARP-TAILED GROUSE (*Pedioectes phasianellus*): "Prairie chickens" were never present in numbers comparable to Ruffed Grouse, although they too were periodically very common. Not until the fall of 1909 (Table 1) was the first chicken bagged. James Hodgson (*in litt.*) asserts that they were not seen for a couple of years after he arrived. There may be two explanations for this: (1) Sharp-tail populations were probably experiencing a cyclic low in 1907 and 1908 (Keith, 1963), and (2) perhaps it was not until agricultural clearing began that the district really became attractive to Sharp-tails.

On May 18, 1921, four nests with eggs were found.

RING-NECKED PHEASANT (*Phasianus colchicus*): During 1925-30, pheasants were released in the Edmonton and Camrose districts (Mitchell, 1959). They were initially seen by the Hodgsons on November 26, 1928, when two hens appeared on Section 17 (Figure 1); during December a cock was observed in the same area. Pheasant numbers increased thereafter, with over 50 reportedly wintering on Section 17 alone in 1939-40. Nineteen cocks were shot during October 13-18, 1941.

GRAY PARTRIDGE (*Perdix perdix*): "Hungarian" partridges were first noted in the spring of 1919 on Section 17 (Figure 1). James Hodgson was familiar with these birds in the old country, and was greatly surprised upon hearing them calling on his homestead. This particular group of partridges had probably originated from introductions made near Calgary (160 miles south) during 1908-12. The first diary mention of hun shooting was on October 3, 1929, when two were taken.

ACKNOWLEDGMENTS

I am indebted to James Hodgson, Edmonton, Alberta, for access to his family diaries, and for assistance in interpreting and supplementing information therein. Robert A. McCabe, University of Wisconsin, kindly read the manuscript and made helpful suggestions for improvement.

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RANGE EXTENSIONS OF SOME BIRDS IN WESTERN MACKENZIE

W. EARL GODFREY
National Museum of Canada, Ottawa, Ontario

IN THE SUMMER OF 1958, a field party of the National Museum of Canada, composed of Stewart D. MacDonald and W. John Smith, gathered information on the birds of Mackenzie Valley, N.W.T., and collected and preserved specimens of the bird populations in the areas visited.

MacDonald worked alone at Fort Simpson from May 28 to June 21. He was then joined by Smith and they worked together in the Fort Norman region from June 22 to July 27. Several days (July 14 to 17) were spent on the north shore of Keith Arm, southwestern Great Bear Lake. Brackett and Kelley lakes, north of Fort Norman, also were visited briefly at other times. From July 28 to August 8, the Norman Wells region received attention and in that period the Canol Road between Canol and Carcajou River was worked (August 5 to 7). From August 12 to 26, they were in the Aklavik region except on August 19 and 20 when a short air trip was made to Herschel Island, Yukon Territory.

Following are the more significant distributional data secured by the expedition.

Accipiter striatus velox (Wilson), SHARP-SHINNED HAWK

A first-year male near Mount Goodenough, Aklavik Range, on August 26 was collected by MacDonald who observed also single individuals in that vicinity on August 22 and 23. These records support the sight record of Preble (1908) somewhat farther south, below the site of old Fort Good Hope. In Yukon, Irving (1960) has recorded it almost as far north, at Old Crow.

Pandion haliaetus (Linnaeus), OSPREY

Although not definitely known to nest in Mackenzie north of Great Slave Lake, there is evidence that its breeding range may extend north to Great Bear Lake. At least one specimen has been taken as far north as Fort Good Hope (Preble 1908). Richardson (1851, Vol. 1, p. 202) mentions nesting along Bear Lake River. In that general region, MacDonald and Smith observed one at Fort Norman on July 11, and two at Fort Frank-

lin on July 14. They were told that the Osprey nests on the south shore of Great Bear Lake but could not confirm this.

Falco columbarius bendirei Swann, PIGEON HAWK

Observed north to Reindeer Depot where a family group of two adults and four fully-fledged young were found. The young roosted in tall dead spruces in a sheltered ravine and the ground below was littered with remains of small birds, especially Yellow Warblers. Two of the young hawks were collected. This species was observed near Aklavik and Kittigazuit by Höhn (Höhn and Robinson 1951) but Porsild (1943) did not encounter it.

Falco sparverius sparverius Linnaeus, SPARROW HAWK

One of two specimens seen at Mount Goodenough along Husky Channel was collected on August 22 and the species was observed also at Aklavik.

Porzana carolina (Linnaeus), SORA

On July 15, four were seen or heard by MacDonald at a small lake twenty miles east of Fort Franklin. One was observed at about ten feet, too close to be collected. On July 10, three were heard (including the unmistakable whinny) about Brackett Lake. On August 2, one was seen about eight miles east of Norman Wells. At Fort Simpson a male was collected on May 31. The species does not seem to have been recorded previously north of Forts Simpson and Rae (Preble, 1908).

Charadrius vociferus vociferus Linnaeus, KILLDEER

At Aklavik, a female in juvenal plumage, with long down adhering to the tips of the central tail feathers but with fully developed remiges and therefore capable of strong and sustained flight, was collected on August 18 by Smith. The young bird was accompanied by two perturbed adults, the actions of which suggested that at least one was a parent of the young bird. The Killdeer has been recorded once previously at Aklavik, by Höhn (Stevens and Höhn, 1958), a single observed there on June 7, 1955. At Fort Simpson in 1958, MacDonald noted up to four Killdeers regularly from May 29 to June 19 when he left the locality. An adult male taken at Fort Simpson on May 31 had a brood patch. MacDonald and Smith observed two individuals at Brackett Lake on July 10. The breeding range in Mackenzie heretofore thought to extend northward to Great Slave Lake, includes also Fort Simpson and perhaps extends locally even farther north.

Bartramia longicauda (Bechstein), UPLAND PLOVER

Between the Carcajou and Mackenzie rivers, west of Norman Wells, S. D. MacDonald collected a specimen and saw another the next day. William MacDonald earlier found the species breeding in the mountains west of Carcajou River (Rowan 1926). The A.O.U. Check-list (1957) includes only southern Mackenzie in the breeding range of this species.

Dendrocopos pubescens nelsoni (Oberholser), DOWNY WOODPECKER

Singles were noted at Fort Simpson on May 29 and June 10. A male collected on the Carcajou River at Canol Road, west of Norman Wells, by MacDonald, is the northernmost Canadian record although in Alaska it has been detected north to near Tanana (Dice, 1920) in about the same latitude.

Tyrannus tyrannus (Linnaeus), EASTERN KINGBIRD

At Fort Simpson singles were observed on June 6, 9, and 12, and an adult male was taken on June 6. At Norman Wells a group of four, thought to be a family, was observed on August 2, and an adult male was collected by MacDonald. Heretofore the species has been recorded north to Forts Simpson and Rae (Preble 1908).

Empidonax flaviventris (Baird and Baird), YELLOW-BELLIED FLYCATCHER

At Fort Norman two adult males were taken on July 9 by Smith. One had a brood patch. The writer knows of no previous record north of southern Great Slave Lake.

Hirundo rustica Linnaeus, BARN SWALLOW

At Fort Norman a nest was seen on July 27 which, MacDonald was told, contained five young a week earlier. Richardson (Swainson and Richardson 1831) recorded nesting at Fort Franklin.

Corvus brachyrhynchos Brehm, COMMON CROW

At Fort Simpson, MacDonald observed it in daily numbers varying from one to four. He collected an adult female there on June 9, and observed a nest with five young on

June 17. Preble (1908) tells us that, when he wrote, Fort Providence was near the northern limit of the range of this species and that it seldom reached Fort Simpson.

Myadestes townsendi townsendi (Audubon), TOWNSEND'S SOLITAIRE

Along the Carcajou River, near Canol Road, some 22 miles from Norman Wells, Smith collected a juvenal male and observed another individual. Preble (1908) recorded adults and flying young at the mouth of Nahanni River. Williams (1933) saw two at Mount Charles on August 12, 1922.

Regulus calendula calendula (Linnaeus), RUBY-CROWNED KINGLET

At Mount Goodenough, Aklavik Range, MacDonald collected an adult male on August 23 and observed two individuals on the previous day. Porsild (1943) did not encounter it on the Delta.

Bombycilla cedrorum Vieillot, CEDAR WAXWING

A lone female was collected at Fort Simpson on June 18 by MacDonald.

Vireo olivaceus (Linnaeus), RED-EYED VIREO

Near Fort Norman singles were recorded on June 26 and 30; July 5, 10, and 12; and a specimen was collected on July 5. At Norman Wells a single was observed on August 1 by MacDonald. These records support earlier observations north to Wrigley by Preble (1908) and Williams (1933).

Vireo gilvus swainsonii (Baird), WARBLING VIREO

Near Fort Norman, Smith collected two specimens: a female with brood patch at Bluefish Creek on July 8 and an unsexed individual at the mouth of Great Bear River on July 9. The A.O.U. Check-list (1957) gives Fort Simpson and Fort Smith as northern breeding localities in Mackenzie.

Mniotilta varia (Linnaeus), BLACK-AND-WHITE WARBLER

At Fort Norman two adults were taken on July 1, one with a brood patch, by MacDonald and Smith. Still farther north, at Norman Wells an immature female was taken on August 1 by Smith. Preble (1908) also recorded it at Fort Norman. The A.O.U. Check-list (1957) gives Fort Simpson as a northern breeding locality in Mackenzie.

Dendroica magnolia (Wilson), MAGNOLIA WARBLER

A single adult male was collected near Fort Norman on June 30 and two individuals on July 7. One was observed on Carcajou River east of Norman Wells, on August 6. These records confirm an earlier report by Höhn (1956) of three singing males near Norman Wells.

Dendroica tigrina (Gmelin), CAPE MAY WARBLER

At Fort Simpson an adult male was collected on May 29 and another on June 1. Singles were observed there also on June 3, 14, and 16. Preble (1908) mentions a male collected there on May 25, 1905. These are the northernmost records for the species in Canada.

Dendroica castanea (Wilson), BAY-BREASTED WARBLER

Heretofore Williams's (1933) sight record of several near Wrigley has seemed surprisingly far north for this species. However, at Fort Simpson, MacDonald took a male on June 7 although he saw no others.

Dendroica palmarum palmarum (Gmelin), PALM WARBLER

At Fort Norman a series of six adults were collected between June 30 and July 5, three of them with brood patches. Two adults were taken at Kelley Lake, 45 miles northwest of Fort Norman. In the Norman Wells region three were seen on July 29; one on August 1; and five on August 2. This extends the known range considerably northward as the A.O.U. Check-list (1957) gives Forts Simpson and Providence as northernmost breeding localities in Mackenzie.

There is an accidental occurrence of this species on the north coast of Mackenzie, a specimen collected at Bernard Harbour on September 28, 1915, by F. Johansen, in the National Museum of Canada.

Agelaius phoeneceus arctolegus Oberholser, RED-WINGED BLACKBIRD

At Brackett Lake, 35 miles north of Fort Norman, an adult male, an adult female, and a juvenal female were collected on July 10 and nine individuals were seen. A male and a female (with brood patch) were collected twenty miles east of Fort Franklin. One was seen at Norman Wells on June 23.

Euphagus cyanocephalus (Wagler),
BREWER'S BLACKBIRD

A female, collected at Fort Simpson by MacDonald, seems to be the first record for Mackenzie. There is, however, a more northern Canadian record, a specimen recorded by Snyder (1925) from Baker Lake, Keewatin.

Molothrus ater (Boddaert), BROWN-HEADED COWBIRD

A sight record by MacDonald of two in the Fort Norman region, on July 2, supports the observation of one still farther north, at Norman Wells, by Höhn (1956).

Piranga ludoviciana (Wilson),
WESTERN TANAGER

At Fort Simpson, MacDonald collected a single male on May 28 and observed another individual on June 14. Preble (1908) records a specimen, listed in the U.S. National Museum catalogue, taken at Fort Simpson on May 31, 1860.

Pheucticus ludovicianus (Linnaeus),
ROSE-BREASTED GROSBEAK

At Fort Simpson, MacDonald collected two first-year males on June 16 and 17, respectively. He saw one on June 14. Soper (1942) observed the species south of Great Slave Lake. Williams (1933) noted it in northeastern British Columbia but it is not clear whether or not he observed it also in southern Mackenzie.

Carpodacus purpureus (Gmelin),
PURPLE FINCH

At Fort Simpson, MacDonald observed this species daily from May 29 to June 16, between one and six per day. Males were singing and a female collected on June 8 had an egg in the oviduct. The A.O.U. Check-list (1957) does not include Mackenzie in the range of the Purple Finch and gives Peace River Landing and Fort Chipewyan, as northern localities in Alberta, although Soper (1942) found it breeding farther north at Hay Camp and observed its occurrence north to Fort Smith, Mackenzie.

The only Mackenzie specimen available appears to be referable, because of its paleness, to *taverneri*, described by Rand (1946).

Passerherbulus caudacutus (Latham),
LE CONTE'S SPARROW

Breeds at Fort Simpson where MacDonald collected four males and a female between June 3 and 15. The female had an egg in the oviduct. Previously in Mackenzie it has been detected only south of Great Slave Lake.

Pooecetes gramineus confinis Baird,
VESPER SPARROW

The A.O.U. Check-list (1957) extends the breeding range north to 'below Norman'. This doubtless is based on Williams's (1933) report of two nesting 'below Norman'. Preble (1908) noted the species north only to Fort Smith and our 1958 party noted only a single individual, a male taken at Fort Simpson on June 6.

Spizella pallida (Swainson),
CLAY-COLORED SPARROW

A single individual at Fort Simpson was observed by MacDonald on June 3, 17, and 18.

Zonotrichia querula (Nuttall),
HARRIS'S SPARROW

At Cloud Bay of Keith Arm, southwestern Great Bear Lake, seven were observed on July 16, all of which indicated by their behaviour that there were young in the vicinity. Two adults were collected.

Melospiza georgiana ericrypta Oberholser,
SWAMP SPARROW

On the north shore of Keith Arm, twenty miles east of Fort Franklin, one of two adults seen was collected on July 15. MacDonald observed two also at Norman Wells on August 2. The species has been previously reported north to Fort Norman by Preble (1908) and by Williams (1933).

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THE SPREAD AND PRESENT STATUS OF THE EUROPEAN HARE, *Lepus europaeus hybridus* (Desmarest), IN NORTH AMERICA

PAUL B. DEAN and ANTOON DE VOS
Department of Zoology, Ontario Agricultural College, Guelph, Ontario

THE EUROPEAN HARE, (*Lepus europaeus hybridus* Desmarest) was introduced into North America in four places in the United States and one place in Canada. It was brought over from Europe to provide a type of sport which immigrants to this continent had enjoyed in their European homelands. In nearly all cases, after hares succeeded in escaping, or were liberated, they proceeded to multiply and spread.

The dispersal of the European hare has been watched throughout the years with interest, but until this time, publications have dealt separately with populations in Canada and the United States. The purpose of this paper is to relate the histories of the two populations and to describe their present day status.

SPREAD OF THE HARE IN CANADA

The population of hares in Canada is limited to southern Ontario and possibly to the southwestern portion of Quebec. It originated from seven

females and two males brought from Germany to the Bow Park Farm, near Brantford, in 1912 (Reynolds, 1955). During the winter the hares escaped from the farm and began to spread into the surrounding country (Figure 1). The earliest report of a hare in the wild was in 1919 (Anderson, 1923) from Aylmer in Elgin County. By 1921-22 the hare had spread rapidly in an east-west direction forming a narrow belt reaching from Sarnia, 1920 (Saunders, 1932) to the Niagara Peninsula on the east (Dymond, 1922). The northern limit of the range ran through Ingersol, Oxford County (Dymond, 1922), and Guelph, Wellington County (Dymond, 1922). By 1923 the southern boundary of the range was established at Simcoe in Norfolk County (Anderson, 1923), and in 1924, the hare reached the shores of Lake Erie at Port Rowan, also in Norfolk County (Snyder and Logier 1931). The following year (1925), the hare was reported at Woodbridge and Maple as it began its spread eastward and northward (Baillie, 1929). By 1928 it occupied all of southwestern Ontario with reports of its presence at Highgate, Kent County (Dymond, 1928), Walkerton, Bruce County (Dymond, 1928), Flesherton and Meaford in Grey County (Dymond, 1928, 1930), Tottenham, Collingwood and Penetanguishene in Simcoe County (Dymond, 1928; Baillie, 1928; Saunders, 1932). Markham, York County and Uxbridge, Ontario County, formed the extreme eastern penetration by the end of 1928 (Dymond, 1928).

Two years later (1930), it was reported further to the east in Darlington Township, Durham County (Allin, 1940). On September 10, 1936, a European hare was shot in Hallowell Township, Prince Edward County, and in December of the same year it was again sighted in the same area (Snyder *et al.*, 1941).

After this, there was a lapse of 12 years before the next report was made of a range extension in the autumn of 1948 on highway 38 near Hartington (Reynolds, 1955). In 1952, European hares were reported in Pittsburg Township, Frontenac County (Reynolds, 1928) and in 1954-55 they were first seen around Gananoque as reported by Biologist N. D. Patrick of the Ontario Department of Lands and Forests, Kemptville District. The northward movement of the hares was reported by Mr. Wm. Bittle of the Ontario Department of Lands and Forests, Tweed District, when he reported that in the winter of 1959-60 European hares were extending their range north of highway 7. Again in 1960-61, Mr. Bittle reported that the hares were extending their range north, particularly along the eastern side of the District in Frontenac County, and were now established in the Sharbot Lake area. In January 1961, a hare was collected 12 miles south of Ottawa in Carleton County (Youngman, 1962).

The winter of 1961-62 produced numerous records of the rapid eastward movement of the hare along with word of its slower northward expansion. Mr. Bittle again reports (1961-62) that they continue to enlarge their range towards the north and are now found 12 miles north of highway 7 along the western side of the District. D. J. Gawley, Kemptville District, indicates that hares are now common in the Gananoque area (front of Leeds and Lansdowne Township), and present in southern Leeds and western Grenville Counties. There are isolated records in north Burgess Township, Lanark County (*pers. comm.* B. Stephenson, Ontario Department of Lands and Forests) and sightings have been reported a few miles north of Maitland, Grenville County, in the

vicinity of Smiths Falls in Lanark and Leeds Counties and 5 miles east-northeast of Ottawa (Youngman, 1962). Reports of hares in the Gatineau Hills, Quebec, just north of Ottawa, have been received by one of the authors but at the time of writing this has not been substantiated.

Reynolds (1955) reported that the hare had not yet colonized Amherst or Wolfe Islands in the eastern end of Lake Ontario. However, a report written by Mr. George Warner, Conservation Officer, Ontario Department of Lands and Forests, shows a medium population of hares on these two islands for the year 1962, indicating that the hares invaded the islands shortly after 1955. Evidence of European hares was found by one of the authors on a visit to the Main Duck Island located in Lake Ontario, 12 miles east of the most south-easterly tip of Prince Edward County. The lighthouse keeper substantiated this evidence by relating how he had seen, on the island that spring, what he believed to be a European hare. He is of the opinion that the hare crossed from the mainland during the winter when severe conditions formed an ice bridge.

Youngman (1962) reports that more northern distribution may result from planned introductions of hares by the co-operative efforts of the Bancroft Fish and Game Association and the Frankford Fish & Game Club. Youngman (1962) also states, that the record from Burks Falls, Parry Sound County, is far north of the present range of the species, and was probably the result of an unsuccessful local introduction.

Releases of the hare in an attempt to establish them in the Port Arthur-Fort William area, were made in 1942, 1943 and 1945 (Allin, 1950). Survivors were observed up until 1949 but none was seen afterwards (Peterson, 1957).

Since its introduction in 1912, the European hare has spread its range approximately 300 miles in an easterly direction, and approximately 150 miles in a northerly direction. Judging from its past record in Ontario the hare will probably continue to advance easterly, but its progress northward will be much slower since the open farmland habitat diminishes in the area of the Pre-Cambrian Shield.

POPULATION DENSITIES

Reynolds (1955) describes the abundance of the European hare in Ontario up to the year 1954. Densities given by him approximate those given by Strandgaard (1963) for the European hare in Denmark, who states that eight hares per square mile is considered a low density, 29 hares per square mile a medium density, and 117 hares per square mile a high density.

Recent estimates of the numbers of European hares in Ontario have not been published thus the following account must be limited to general statements.

Youngman (1962) states that there are, at present, few hares in the Ottawa district. However, to the west European hares are abundant and increasing in numbers in the area of Madoc in Hastings County, and they seem firmly established in the Gananoque-Lansdowne area in Leeds County. An unpublished report (1962), by Conservation Officer George Warner, Ontario Department of Lands and Forests, shows the hare density as "heavy" in Prince

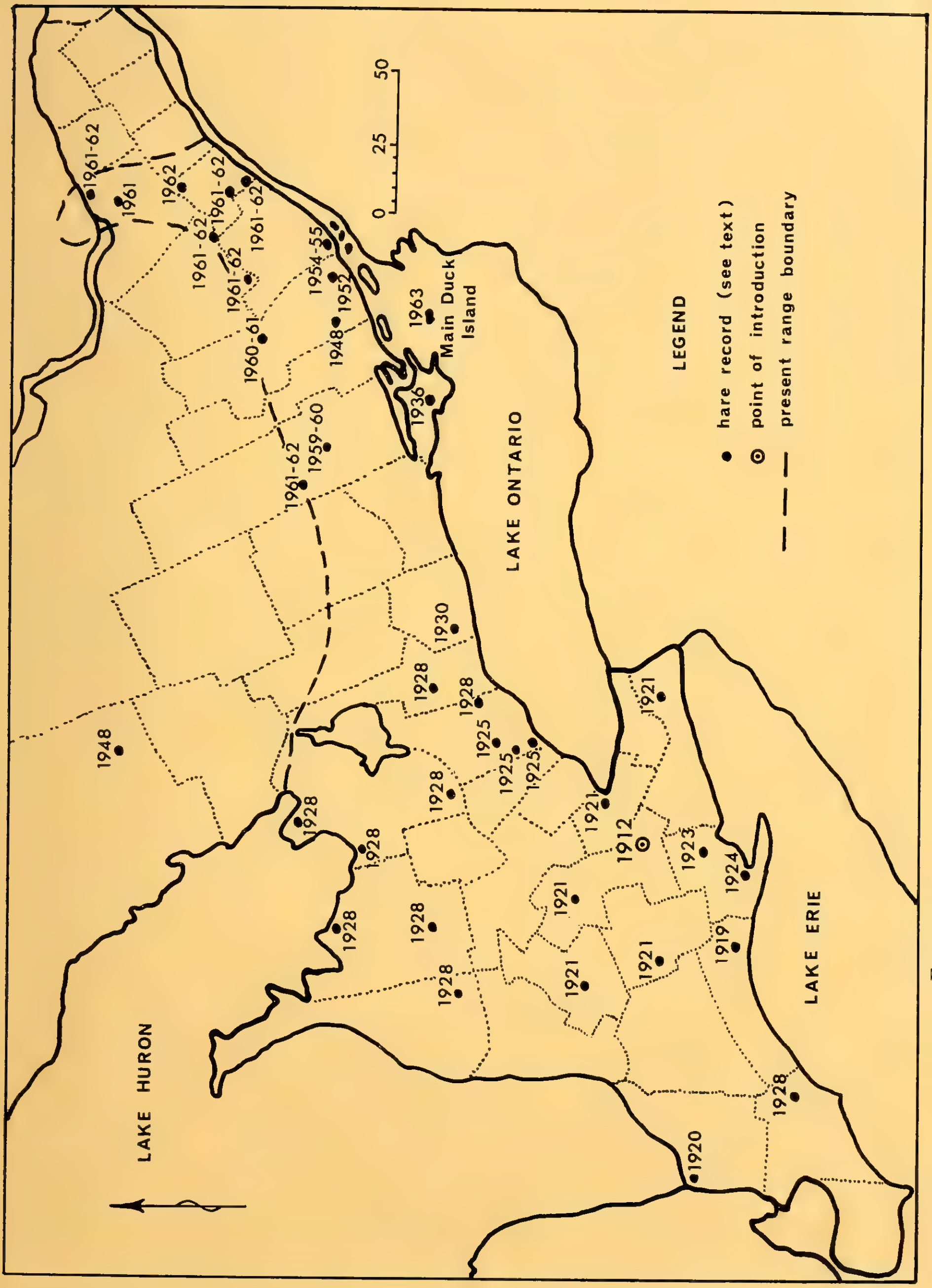

FIGURE 1. The spread of the European hare in Southern Ontario.

Edward County and in a belt about 10 miles wide along the shore of Lake Ontario north of the aforementioned County. He indicates a population of "medium" density for a belt of about 25 miles wide north of the heavily populated area and also for Amherst and Wolfe Islands in Lake Ontario. From here to the northern extremity of its range the hare is considered rare. Unpublished reports from the Ontario Department of Lands and Forests, although they do not give a complete picture, indicate that the European hare is common to abundant in the parts of its range west of Prince Edward County.

SPREAD OF THE HARE IN THE UNITED STATES

The European hare was introduced in four different localities in the New England States (Figure 2). Silver (1924) states that probably the most successful took place in 1893 at Millbrook, Dutchess County, N.Y. This was the first of a number of shipments, some of which consisted of 500 animals each, made at intervals of four or five years, the last being in 1910-11. The number of hares introduced was increased by a smaller number imported and liberated at a neighbouring estate.

An earlier importation was made at Jobstown, New Jersey in 1888, but without the impetus of number given at Millbrook, New York. An importation was also reported at Bethlehem, Pennsylvania, and another at White Plains, New York (Silver, 1924).

The first report of hares dispersing from the successful introductions is documented by Rhoads (1903). He states that hares became scattered over many localities in the northern half of New Jersey, and were found sparingly in the wild parts of Camden and Burlington Counties. Hares were regularly hunted in Bucks County, Pennsylvania.

For the most complete account of the early spread of the European hare in the United States we are indebted to James Silver (1924). He describes the range in 1924, as extending from southern Vermont to central New Jersey and eastward 20-30 miles into Connecticut and Massachusetts, and to a limited extent, westward across the Hudson and Delaware Rivers into extreme eastern Pennsylvania (Figure 2). Later, a European hare was taken at Rensselar, Rensellar County, New York (Schoonmaker 1929).

Goodwin (1935) states that the European hare was scattered over most of the State of Connecticut, and was becoming quite numerous in certain portions of Fairfield and Litchfield Counties. He goes on to say that state trapper's reports included 16 hares killed during the winter of 1927-28 at the following localities: Morris and Litchfield Reserve, 4; Tunxis Reserve, 4; Camp Columbia, 6; and Kent Falls Park Reserve, 2. All these locations fall within the range given by Silver (1924), which indicates that the advance of the hare into new territory had almost come to a stop.

Osgood (1938) reported that several European hares had been killed in or near southwestern Vermont, and that reports were also frequently heard of hares from other sections of southern Vermont, but no specimen had been examined. This is the last report of a range extension that we have in the eastern states. For some unknown reason the population subsequently began to decrease resulting in a shrinking of the range occupied by this animal.

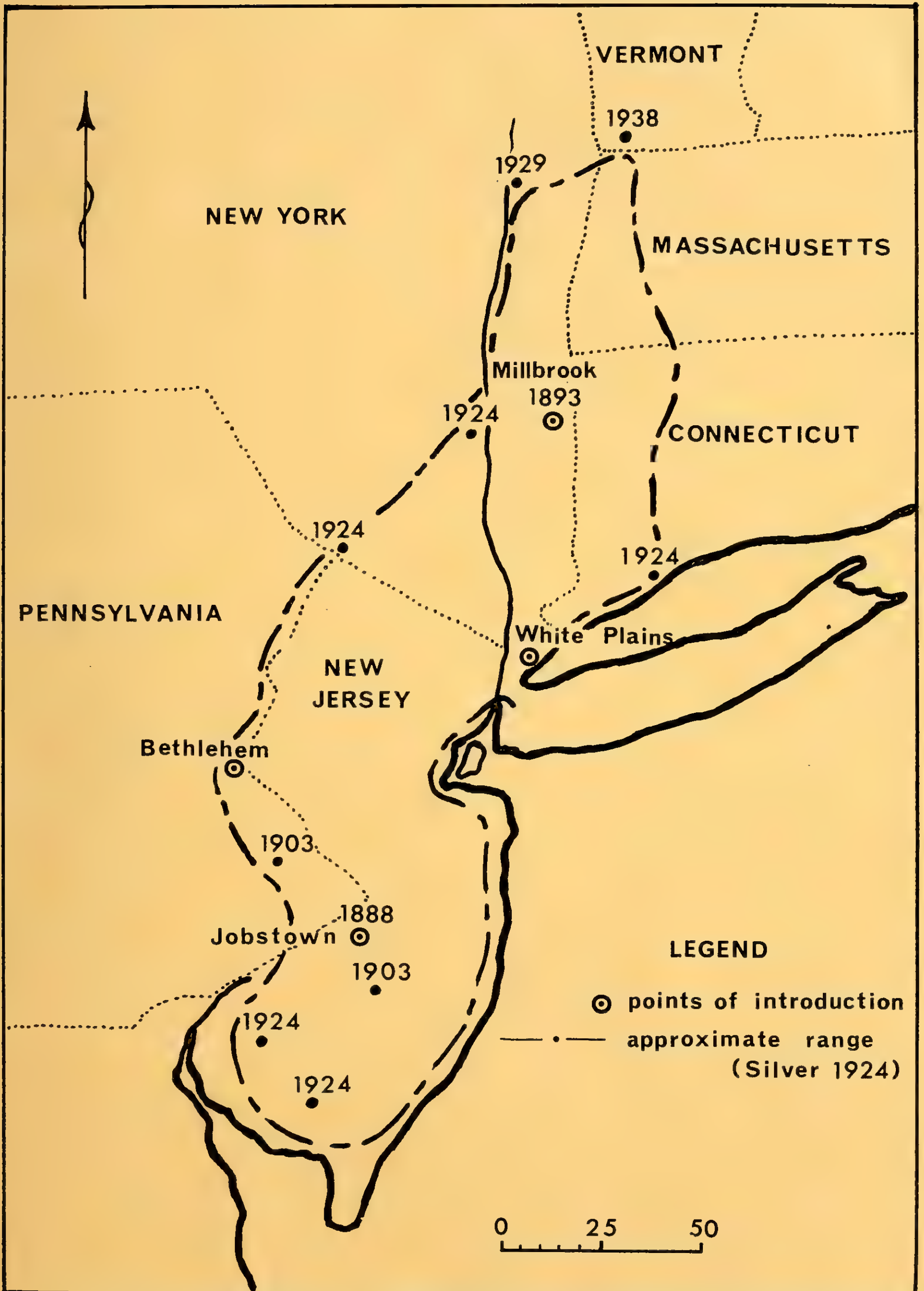

FIGURE 2. Early distribution of the European hare in the United States.

A mammal survey of northeastern Pennsylvania conducted by Grimm and Whitebread (1952) failed to locate any European hares in that part of the State, and personal communications with two research biologists in the State confirm the fact that no European hares are found anywhere in Pennsylvania to-day. Similarly correspondence with biologists in Massachusetts and New Jersey reveals that the European hare no longer exists in these States.

Smith (1955), remarked that a few European hares still survive in the lower Hudson Valley of New York from the expanding populations of the early 1800's.

To-day the only existing populations of hares remaining in the United States are in a number of isolated areas in the States of New York and Connecticut (*pers. comm.*). Presnall (1958) also reports a few European hares in Kent County, Maryland.

Joseph Dell of the State of New York Conservation Department (*pers. comm.* 1963) gives us a detailed account of the present range of the European hare in New York. "Three major and apparently isolated populations exist (Figure 3). The largest area occupied is made up of the northeastern half of Dutchess and the two southeasternmost townships of Columbia counties. This population persists in the area originally stocked from 1893 to 1911."

"A second population is found in a narrow belt running from the western border of Herkimer County and including the southernmost tier of townships in that county, eastward along the Schoharie-Montgomery Counties border, the full length of the latter county and including about one tier of townships in each. Small belts along the northeastern edge of Otsego County and the northwesternmost edge of Schenectady County are also included in this colony."

"The third occupied range which appears to be considerably smaller than the other two, occurs in west central Washington County."

"There are indications that a few European hares may also exist in northwestern Chenango County, southern Onondago County, northwestern Onondago County, southeastern Saratoga County, west-central Albany County, northwestern Columbia County, southwestern Ulster County, northeastern Putnam County, and the northern edge of Nassau County, Long Island. Road killed specimens have been collected at the first two mentioned locations. In addition, there have been a few authentic records of hares killed on the highway in the central part of the State, near the Finger Lakes."

Arroll Lamson, of the Connecticut State Board of Fisheries and Game, describes the present boundaries of the population of European hare in Connecticut as three apparently isolated colonies in Litchfield County. The southernmost including the southeastern and southwestern corners of Roxbury and Woodbury Townships respectively (Litchfield County), and the north-central portion of Southbury Township, New Haven County. The middle colony includes all of Bethlehem Township and parts of Morris, Washington, Roxbury and Woodbury Townships. The northernmost colony includes the eastern half of Harwinton Township, the northern third of Plymouth Township in Litchfield County, and the western third of Burlington Township, Hartford County.

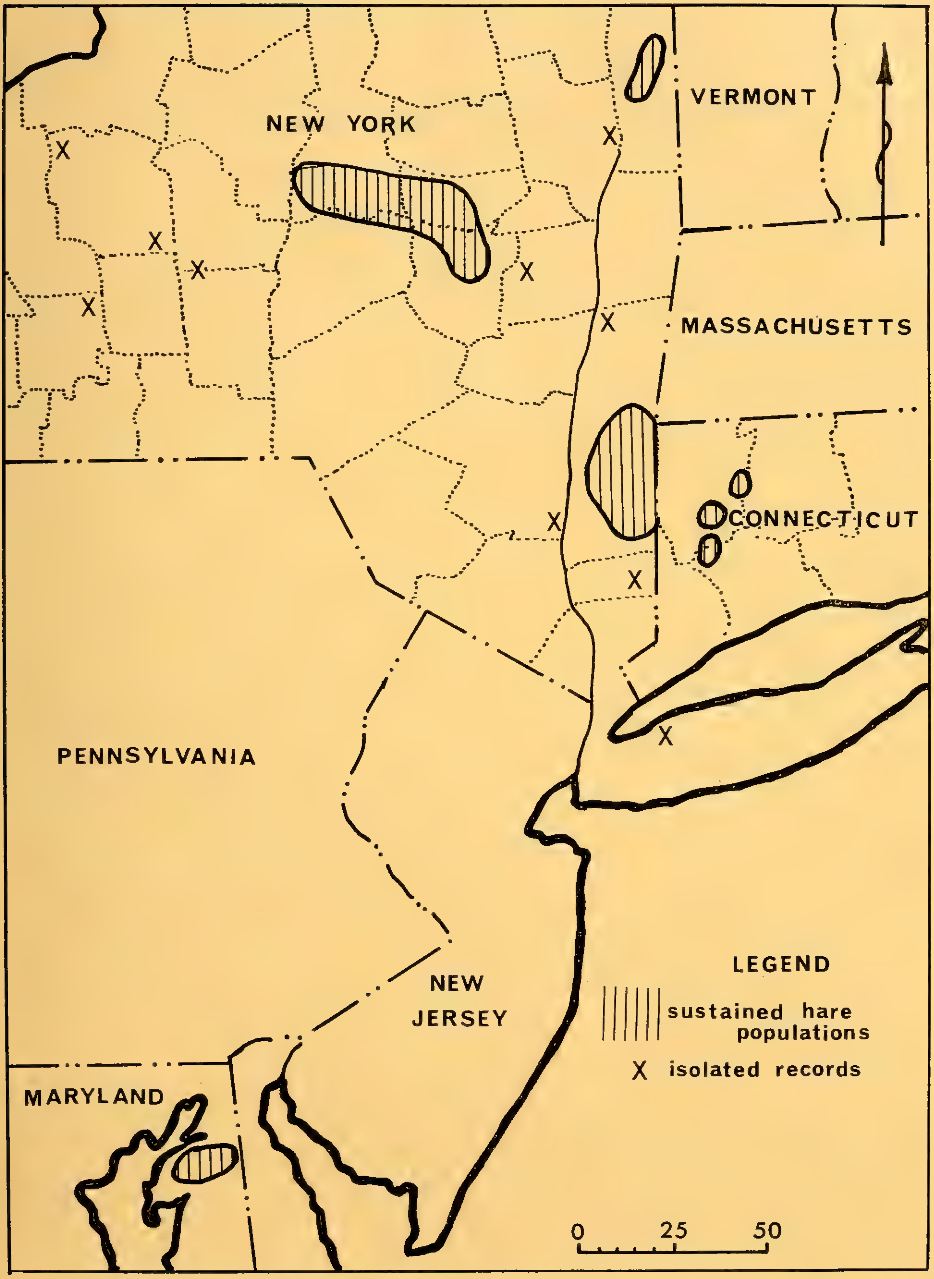

FIGURE 3. Present distribution of the European hare in the United States.

Burt (1954) shows numerous locations where hares have been reported in Michigan. However, in a personal communication, he explains that the European hare has never become established in Michigan and that the records he has documented are only locations where hares have been taken at various times. These animals probably crossed from Ontario. The earliest record of a European hare in the State is in the winter of 1933-34 in Tuscola County.

POPULATION DENSITIES

There are few records of the actual density of the early population of hares in the United States. We can, however, get a general idea of the relative abundance from the remarks of the various authors. Rhoads (1903) indicates that the population was sparse in the northern half of New Jersey since he says that the species is found sparingly in Camden and Burlington Counties.

Silver (1924) gives the only clear picture of the population. He estimated, from bounty records, that there were 5,000 hares in Dutchess County or six hares to the square mile. Based on a study of tracks in the snow near Sheffield, Massachusetts, a population of 20-40 hares per square mile was reported in that vicinity. In New Jersey they were reported to be numerous in the vicinity of Stelten, Middlesex County.

Goodwin (1935) reported that the hare was becoming quite numerous in certain portions of Fairfield and Litchfield Counties in Connecticut.

After this, all reports seem to indicate that the population was dwindling (Osgood, 1938; Smith, 1955), and even today, the abundance of hares in the United States is very low as indicated by Dell (*pers. comm.*) in a report that gives the hunting statistics for four counties in New York State. With a total of 272½ man-hours hunting, only 27 hares were seen, which is an average (for 18 hunts) of 10.1 man-hours per hare seen.

Reports of the population of hares in Connecticut indicate that it also has been declining over the past years and that it is very low at present. In the biennial report of the State Board of Fisheries and Game 1934-36, 62 hares were taken by state trappers. In 1944, the town of Morris paid a bounty on 50 hares taken. A survey being presently made of bounty payments, yet incomplete, shows that of 25 towns making up the area of heaviest infestation in the past years, 17 towns report paying no bounties. The estimated population at present is from two to four animals per square mile as contrasted with an estimate of 20 to 40 per square mile during the period of greatest abundance in 1927.

According to Arroll L. Lamson, Chief of the Game Division of the Connecticut State Board of Fisheries and Game (*pers. comm.*) the main reason why the European hare has declined in recent years is because much of the open land (farms of western Connecticut) have now reverted to brushland and woodland. This has limited the habitat so that the hare can more readily be taken by sportsmen.

DISCUSSION

The foregoing account of the spread of the hare in Canada and the United States brings two obvious questions to mind. Why did the population in the

United States decline after a short flourish when the population in Ontario thrived and expanded so rapidly? Also, why have hares not crossed over into the United States where the two countries are separated only by a river which in all cases (St. Clair, Niagara and St. Lawrence), freezes over at some time during the winter? If such a crossover had occurred, and a population had become established, it is very probable that its occurrence would have come to the attention of the proper authorities in New York State and be a matter of record. To date, no such record exists. On the other hand, numerous hares have crossed into Michigan and yet a population has still not become established in that State (Burt, *pers. comm.*).

These questions are even more puzzling when it is realized that the habitat in New York State and Ontario is practically identical. Dell (*pers. comm.*) describes the occupied range of the hare in New York State as predominantly dairy country. The terrain is open, made up largely of pasture and hay fields, broken by occasional grain or other crop fields, bush lots or small woodlots. Hedgerows between open fields are an important feature of the landscape. In Ontario this same type of habitat supports substantial populations.

It has been suggested that hunting pressure in the United States has been responsible for the population decline. However, the effect of increased hunting on game populations has indicated, in various instances, that the rate of reproduction of the game species increases to compensate for the increased hunting pressure. A recent talk with Dr. Strandgaard of the Danish Vildtbiologisk Station, Kalø, brought to light the fact that this seems to be the case with the European hare populations in Denmark which are exposed to heavy hunting pressure. Just exactly how or why this phenomena functions is not clear, but it tends to contradict the idea that hunting pressure reduced European hare populations in the United States to such low numbers. Moreover, hunting pressure in Europe is much higher than anywhere in the United States in places where the hare populations are high. Whatever the cause or causes, it will be interesting to compare the future trends in the two populations.

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NOTES ON THE COLD-BLOODED VERTEBRATES OF THE NABISIPI RIVER REGION, COUNTY DUPLESSIS, QUEBEC

G. Power
Department of Biology, University of Waterloo, Waterloo, Ontario

Introduction

In 1960 the Quebec government established a research station in the estuary of the Nabisipi River which flows into the north shore of the Gulf of St. Lawrence, some 180 miles east of Sept Iles. Activity at the station is primarily directed towards finding means of improving stocks of Atlantic Salmon in North Shore rivers. During the summers of 1961 and 1962 the author had the privilege of working at the station and was able to make numerous observations on the fauna of the region, particularly the fish fauna.

Prior to 1950 little attention had been paid to the cold-blooded vertebrate fauna of the Quebec-Labrador Peninsula. Recently a number of works have appeared which deal specifically, or in part with this area, the most important of which are those of Dunbar and Hildebrand (1952), Backus (1957), Bleakney (1958) and Harper (1961). All these works include extensive bibliographies. There are still many parts of the peninsula which are relatively unknown and in which no serious collecting has been done. There is a need for more detailed information on the distribution of cold-blooded vertebrates in such areas to provide, among other things, more evidence about post-glacial dispersal of species into the peninsula and more accurate knowledge of the range and abundance of many species that penetrate into the region. This paper is a series of notes and observations made in an area which is little known except to sportsmen who are attracted there for salmon and trout fishing.

Fish

During the course of salmon investigations extensive seining both by day and by night, was done in the estuary and the lower 30-mile stretch of the Nabisipi River. In addition a number of collections were made using rotenone. Overnight gillnet sets were made in Lac Saumur and Lac Jerome, two lakes in the watershed of the Nabisipi River. Using rotenone and small seines, collections of fish were made in the Aguanus River, five miles to the east of Nabisipi River and in a number of small streams within walking distance of the research station.

The places where fish were collected in the vicinity of the research station are shown on the map, Figure 1. For the positions of other collections reference should be made to sheet 12 N.W., Mingan Cape Whittle, National Topographic Series, Canada Department of Mines and Technical Surveys. Each collecting station is numbered and a brief description of each is given in the appendix following this paper.

Collections of small fish were preserved on the spot in 5 per cent formalin and stored in this solution for up to five months. The formalin was then washed out and the specimens transferred to 40 per cent isopropyl alcohol for permanent storage. Measurements were made after the fish had been in alcohol for some months.

A number of fish were collected in or near the estuary of Nabisipi River which are primarily marine. They are all known to inhabit the waters of the Gulf of St. Lawrence and there is nothing unusual about the records. They are listed here for the sake of completeness.

Clupea harengus harengus Linnaeus, Atlantic herring
Gadus morhua Linnaeus, Atlantic cod
Microgadus tomcod (Walbaum), Atlantic tomcod
Myoxocephalus Scorpius (Linnaeus), shorthorn sculpin
Hemitripterus americanus (Gmelin), sea raven
Pseudopleuronectes americanus (Walbaum), winter flounder
Ammodytes hexapterus Pallus, American sand lance
Cyclopterus lumpus Linnaeus, lumpfish
Mallotus villosus (Müller), capelin

The rest of the fish are either anadromous, euryhaline or freshwater species and these will be dealt with systematically. After the name of each species, the numbers of the collecting stations it was obtained from are given. Where specimens have been deposited in a Museum collection, other than that of the University of Waterloo, the catalogue number is given. National Museum of Canada numbers are proceeded by NMC, Royal Ontario Museum numbers by ROM.

Acipenser oxyrhynchus Mitchill, ATLANTIC STURGEON

Station: 1. This species is an occasional visitor to the Nabisipi estuary but it is unlikely that it penetrates beyond the falls at the head of tidal water. Two specimens were taken in 1962 each about three feet in length. It is sometimes caught in the estuaries of neighbouring rivers.

Coregonus clupeaformis (Mitchill) LAKE WHITEFISH

Stations: 1, 2, 6. *Collection*: ROM 22733. This species is rare in Nabisipi River proper but a good population exists in this water shed in Lac Jerome (6) and possibly in some other lakes in the area. The population in Lac Jerome may be stunted. A sample of 50 or so examined in 1962, taken in an overnight gill-net set, were uniform in size averaging about a pound in weight. Two specimens taken in the estuary in 1962 were over two pounds in weight, and two out of the three specimens taken in the river in 1962 exceeded this weight. The Indians living at the mouth of the Natashquan River fish in its estuary for a species of whitefish which is almost certainly *C. clupeaformis*. One partly decomposed head that was found near one of their fishing sites was identified as belonging to this species.

Salmo salar Linnaeus, ATLANTIC SALMON

Stations: 1, 2, 3, 9. *Collection*: ROM. 22732. Common in the accessible lower reaches of the North Shore rivers but absent from smaller streams. Land-locked populations of Atlantic salmon, *Salmo salar ouananiche* occur in Lac Victor, 50° 34′ N, 61° 50′ W, Lac Holt, 50° 35′ N, 62° 28′ W, and many other suitable lakes in the region. They appear to be absent from Lac Jerome (6) and Lac Saumur (7) in the Nabisipi River watershed but are present in Lac Michaud (5), which is at a lower elevation.

Salvelinus fontinalis (Mitchill), SPECKLED TROUT (BROOK CHAR)

Stations: 1 - 12 inclusive. This species is abundant in the region and well adjusted to the cold clear waters. It occurs in even the smallest streams on the coast (stations 4 and 11), and penetrates to the headwaters of

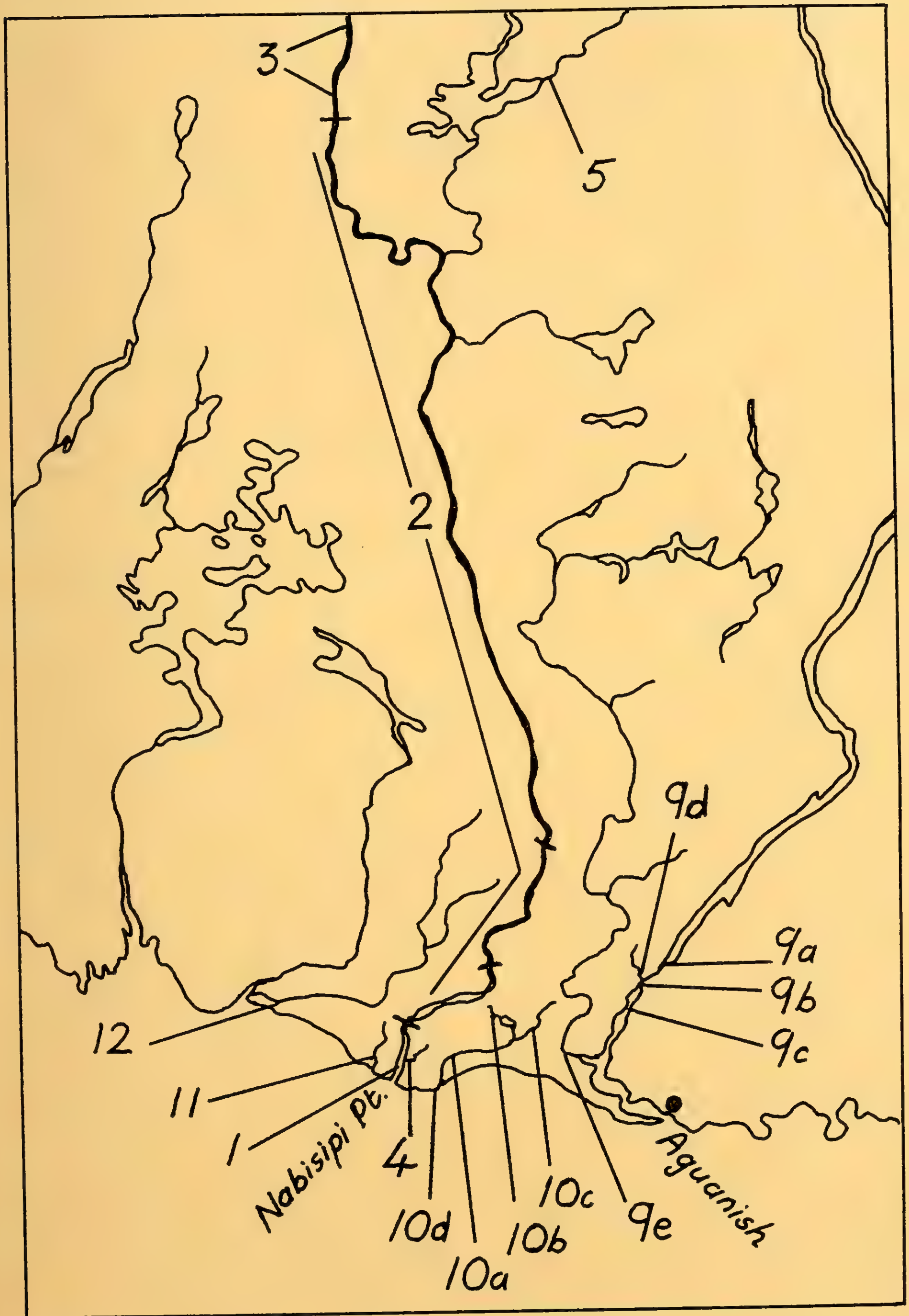

FIGURE 1: Stations (1, 2, 3, 4, 5, 9a, 9b, 9c, 9c, 10a, 10b, 10c, 10d, 11 and 12) where fish were collected in the vicinity of the estuary of Nabisipi River. Scale 4 miles to the inch. Nabisipi River runs up the centre of the map, the Aguanus River is on the right.

TABLE 1. — Length-frequency distribution of 278 underyearling *Catostomus catostomus* from three locations.

Location 1: August 8, 1961; station 2, Nabisipi River, 2 miles above estuary, rock bottomed pool at edge of river (25′ x 90′ x 0–30″).

Location 2: August 9, 1961; station 9e, tributary of Aguanus River.

Location 3: August 22, 1962; station 9a, Aguanus River from shallow sand bottomed pools at edge of river.

Length in mm	14	15	16	17	18	19	20	21	22	23	24	25	26
Location 1				2	9	6	8	6	9	7	1	2	2
Location 2	2	5	2	8	6	11	3	9	8	2	2	3	1
Location 3							2	2	13	9	12	23	25

Length in mm	27	28	29	30	31	32	33	34	35	Total	Mean length
Location 1	3	1		1	2	1				60	21.9
Location 2	1	1								64	19.7
Location 3	20	19	2	13	4	3	3	1	3	154	26.4
										278	

the larger rivers (stations 8 and 10b), and into the smallest tributaries (stations 4, 5, 9d, 9e). In smaller bodies of water stunted or dwarf populations are found, many of which become sexually mature at only a few inches in length. 'Anadromous' forms occur in the estuaries of the larger rivers and here the fish may attain weights of over 4 pounds although 2 pounds is more common. Detailed work on the speckled trout in this region will be the subject of a subsequent paper.

Osmerus eperlanus mordax (Mitchill), RAINBOW SMELT

Stations: 1, 2. This species is common at times in the estuary of Nabisipi River and was taken occasionally during seining operations in the lower reaches of the river in 1962. The majority of smelts taken in August 1962 in the estuary were between 100 mm and 150 mm in length. Some smelts were smaller or longer than this and two other size groups, probably age groups, were present, one with a mean length around 75 mm and the other with a mean length of over 200 mm.

Esox lucius (Linnaeus), NORTHERN PIKE

This is reported to occur in the lower reaches of the Aguanus River where it is known to the locals as 'Le Grand Brochet'. The only record I obtained of it was a visual record of a specimen about 30 inches in length but identification can only be regarded as tentative.

Catostomus catostomus (Forster), LONGNOSE SUCKER

Stations: 2, 9a, 9b, 9c. This species is abundant in the lower reaches of the Nabisipi and Aguanus Rivers. It does not penetrate more than 15 miles above tidal water in the Nabisipi watershed, but is often taken in the estuary where it grows to a weight of about a pound and a half. Young suckers are very abundant in the shallows at the edge of the river during the summer and are often trapped in pools left by receeding water levels. Their size is rather variable perhaps because conditions in the micro-habits they inhabit are so varied, however if a large sample is obtained in one place it exhibits a fairly normal length-frequency

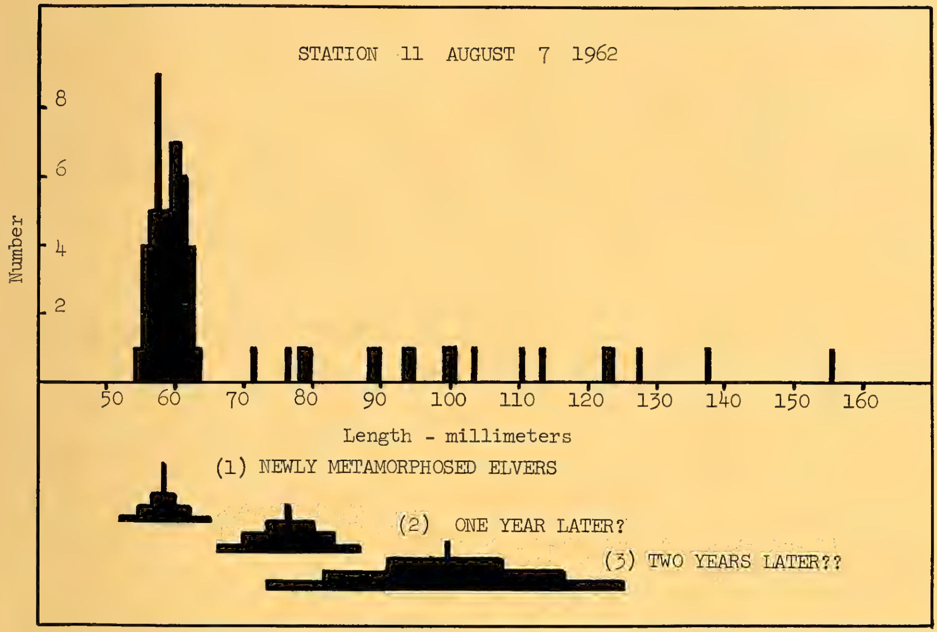

FIGURE 2: The total length-frequency distribution of a sample of 67 eels obtained August 7, 1961 using rotenone in Ruisseau Rundel (station 11). Under the frequency distribution is given the normal distribution of newly metamorphosed elvers, eels after a year ? in fresh water and eels after two years ? ? in fresh water. The centre vertical line marks the mean, the steps on either side of this mark one, two and three standard deviations on each side of the mean. In addition 3 eels total length 186 mm, 301 mm and 345 mm were taken which are too large to include in the figure.

distribution. Table I gives data from three moderate sized samples taken in rather different habitats. The data are not comparable because dates and years differ but the figures indicate the sizes attained by young suckers in this region in August of their first summer.

Anguilla rostrata (Le Sueur), AMERICAN EEL

Stations: 1, 2, 10a, 11. Elvers of the American eel approach the coast in late July and early August. On occasion large numbers of them can be observed attempting to climb the falls at the head of the Nabisipi estuary. A number succeed in making the ascent but they do not appear to penetrate a great distance up the river. In 1962 there was an intensive programme of collecting in Nabisipi River and no eels were collected more than a few miles above the estuary. Once dispersed in the river they are difficult to collect, they are very resistant to rotenone and are not affected by it until long after other species have succumbed. No eels were collected in the five stations sampled with rotenone in the Aguanus River although young eels undoubtedly ascend this river at least as far as the gorge (between stations 9a and 9b).

A collection of 70 eels was obtained on August 7, 1961 from Ruisseau Rundel (station 11). The majority of these (49), were recently metamorphosed elvers, some still transparent others pigmented. They ranged from 55 to 63 mm in length, mean 58.5 mm, S.D. 2.3, and could easily be separated from the older eels in the stream in a length frequency histogram, Figure 2. Growth in this small heavily overgrown stream is probably slow and in Figure 2 the four eels between 70 and 80 mm in length may be eels after one year in fresh water, mean length 76.0 mm, S.D. 3.6, and the group between 93 and 113 mm eels after two years, mean length 98.8 mm, S.D. 8.8. Statistically it seems reasonable to separate these groups but whether this is

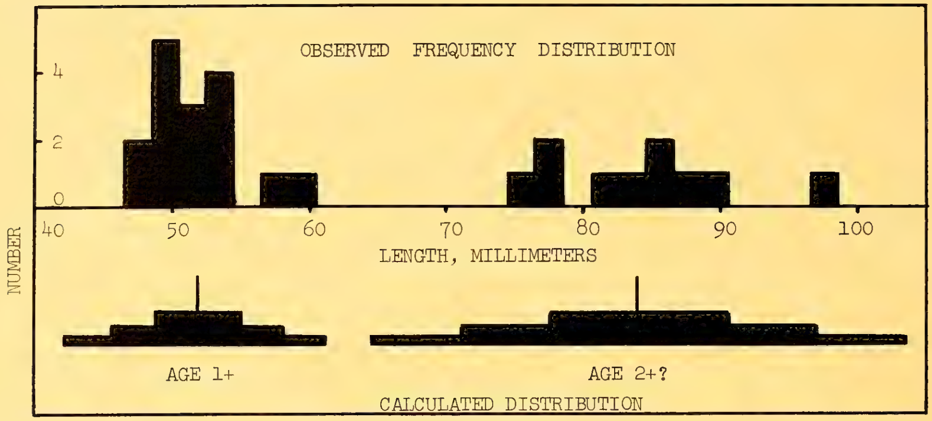

FIGURE 3: The fork length-frequency distribution of 26 specimens of *Hybopsis plumbea*, station 9c, Aguanus River, August 9, 1961. Under the frequency distribution is given the calculated normal distribution of the 1+ and 2+ ? age groups. The mean is the vertical line in the centre, the steps on either side of this indicate one, two and three standard deviations on each side of the mean.

a biologically valid conclusion is uncertain. It indicates a growth of about 17.5 mm during the first year in freshwater and 22.8 mm during the second year.

One large eel taken in Ruisseau Rundel was interesting in that the dorsal fin was broken into three segments instead of being continuous along the back with the caudal. The eel was 345 mm long and the distances along the back to the anterior points of insertion of the three dorsal fins were: 110 mm, 190 mm, and 218 mm. The three dorsal fins were 17 mm, 7 mm, and 12 mm long and approximately 4 mm, 1 mm, and 2 mm in height. The origin of the caudal fin was 292 mm from the anterior and it was 53 mm long on the dorsal side. The eel did not appear to have been handicapped by its deformity, it was in fact, the largest eel taken in this location.

A large collection of eels was taken in one other place. In one of the pools at station 10d, low down the shore and in the splash-zone from spring tides, was an aggregation of large eels between 300 mm and 500 mm in length. These were first observed in August 1961 and were collected August 15, 1962. The water in the pool was of high salinity and rocks in the pool bottom were matted with a growth of *Fucus*. Why the eels should have collected in this one particular pool and apparently ignored others, is not obvious.

Hybopsis plumbea (Agassiz), LAKE CHUB

Station: 9c. Twenty-six specimens of this species were obtained from a pool in which they had been trapped by falling water levels in the Aguanus River on August 9, 1961. Two distinct size groups were recognisable (Figure 3) which may represent the 1+ and the 2+ age groups. No 0+ aged fish were collected in the pool so that either breeding had been unsuccessful, or it had occurred elsewhere. No chub were observed or collected in the river in 1962, although a search was made for them. According to local information at least one and probably two species of minnow occurs in the Natashquan River but unfortunately it was not possible to verify this.

Percina caprodes (Rafinesque), LOGPERCH

Station: 9b. *Collection*: ROM 22730. Six individuals were obtained at station 9b in the Aguanus River on August 22, 1962. They ranged in length from 66 mm to 87 mm. The fish were unknown locally and are probably not common in the area.

Gasterosteus aculeatus Linnaeus, THREESPINE STICKLEBACK

Stations: 1, 2, 3, 4, 5, 9b, 9e, 10a, 10b, 10c, 11. This is the most widely distributed and abundant of the sticklebacks. All three phenotypes occur, trachurus the armoured type is most common in brackish water, semiaramatus and leiurus predominate inland. No attempt was made to determine the

TABLE 2. — Temperatures and salinities in rock pools at station 10c on June 28, 1962.

Pool	Mid-day temperature	Salinity	Notes
1	17.5°C	16‰	Sticklebacks and young
2	17.0°C	2‰	Sticklebacks and young
3	17.0°C	19‰	Sticklebacks no young
4	18.0°C	16½‰	Sticklebacks no young
5	18.5°C	12½‰	Sticklebacks no young
6	15.0°C	20‰	Sticklebacks no young
7	18.5°C	1‰	No Sticklebacks
8	18.0°C	0‰	No Sticklebacks
9	18.0°C	1‰	No Sticklebacks
10	17.0°C	20‰	No Sticklebacks

exact proportions of these types in any locality. It occurs in fresh and esturine waters and numerous populations breed in brackish pools just above the high tide mark on the offshore islands and on rocky promontories along the coast, e.g. station 10c.

In the supra-tidal zone sticklebacks seem to breed successfully in pools with a salinity of between 2‰ (parts per thousand) and 20‰ providing other conditions are suitable. Their residence in the pools is probably temporary. They gain access during equinoctial spring tides of early spring and the young escape during the high September tides and during autumn storms. Many of the pools are so small that they must certainly freeze solid during the winter and during a hot dry summer some of them dry up. The population density in the pools at the beginning of summer is probably determined by chance. Some of the largest of them examined at station 10c contained only a few or no sticklebacks while one small pool 12 by 8 by 2½ feet contained five, possibly six, breeding territories. High up the shore the ponds do not contain sticklebacks presumably because the fish cannot gain access. Low down the shore in the splash zone sticklebacks are absent from the ponds.

On June 14, 1962 the small pond mentioned above had a surface salinity of 11‰ and the mid-day water temperature was 15.5°C. The males were vigorously defending their territories around the edges of the pool and the females were crowded into the centre. Nests were clearly visible in three of the territories and the males were engaged in egg fanning when not chasing intruding females out of their territory. The nests were tubular holes made in sand and silt deposits covering the rock sides of the pool. A neighbouring pond about two feet higher up the shore and about three feet away at the nearest point contained no sticklebacks. It had a surface salinity of 8‰ and a temperature of 15.5°C. Lower down the beach, about two feet below the pond containing the breeding sticklebacks was a pond containing sticklebacks but there was no evidence of nesting having occurred at this date. The surface temperature was 15.25°C. and the salinity 16‰. One foot lower down the beach in the splash zone a pool with no sticklebacks had a surface temperature of 12.25°C. and a salinity of 23‰. One other pool on the promontory was noted to contain breeding sticklebacks on this date. This was a very small pool, 6 by 2 by 1 feet, which had a salinity of 10.5‰ and a temperature of 15.5°C.

Two weeks later on June 28, 1962 the conditions listed in Table 2 were found in ten pools investigated at station 10c.

On July 19, 1961 22 young of the year, *G. aculeatus*, from a pool at station 10c averaged 17.7 mm in length, range 12 to 22 mm. Five young of the year taken in a pool on an island off Pachachibou River on August 6, 1961, ranged between 17 and 21 mm in length. Inland the size of the young is greater, perhaps because of higher temperatures and/or an earlier spawning date.

In Figure 4 the length-frequency distributions of some of the larger collections of *G. aculeatus* are given. It is quite easy in these distributions to separate fish in the first year of life from older fish. Beyond this is not

TABLE 3. — The length-frequency distribution of *Pungitius pungitius* collected June 19, 1962 (Station 10b) and July 16, 1962 (Station 3).

Length mm	40	41	42	43	44	45	46	47	48	50	51	53	56	57	60
Station 10b	1	1	3	1	2	4	4		3					1	
Station 3		1		2		4	2	1	1	2	1	4	1		3

possible to go and the older fish group probably consists of fish in their second, third and perhaps even fourth years. Jones and Hynes (1950) in their study of the age and growth of *G. aculeatus* in England found that length-frequency distribution did not give a reliable indication of age because the fish grew so rapidly during the first summer that there was considerable overlapping of the age groups after the first few months. Under more severe conditions this overlapping of year groups may not occur until the fish are in their second year of life. The sample of *G. aculeatus* obtained on August 20 from station 3, Nabisipi River shows a clear separation of O+ age group fish from older fish and in this region the growing season would not be prolonged much beyond the end of September. It is probable that in a sample taken early in the season fish born the previous year, which would then be entering their second year and belong to the 1+ age group, could be recognised. Farther north this is certainly true. A sample of 101 *G. aculeatus* taken on the 20-21 June, 1955 in Lac Aigneau, 57° 14″ N, 70° 07′ W, showed a clearly defined bimodal length-frequency distribution (Figure 4). In this particular year the ice broke up and went out of the lake on June 4. By June 8 mid-day water temperatures as high as 16°C were recorded in sheltered bays. On the date the sample was obtained spawning had not begun but the females in the sample were nearing maturity. None of the fish entering the second year of life showed evidence of maturity so that in this latitude and under these conditions *G. aculeatus* apparently does not breed until the end of its second year. In the Nabisipi region it probably matures a year earlier and breeds at the end of its first year as it does elsewhere, Jones and Hynes (1950).

A number of specimens from station 10b were noted as containing the plerocercoid stage of the tapeworm *Schistocephalus solidus* (Müller), ≡ *S. gasterostei* (Fabricius), but the incidence of this parasite did not appear to be high.

Gasterosteus wheatlandi Putnam, TWOSPINE STICKLEBACK

Station: 1. *Collection*: ROM 22731. This species was taken on two occasions in 1961 in the estuary of Nabisipi River once alone and once together with *G. aculeatus* and *A. quadracus*. It is smaller than *G. aculeatus*. Nine specimens taken on August 4 ranged between 33 and 41 mm in length, mean 35.9 mm and nineteen specimens taken on August 17 ranged between 35 and 42 mm in length, mean 38.7 mm.

Pungitius pungitius (Linnaeus), NINESPINE STICKLEBACK

Stations: 2, 3, 9e, 10b, 11. Widely distributed but very much less abundant than *G. aculeatus*. On June 19, 1962 a sample of 20 specimens was taken at station 10b. The males were in jet black spawning colouration and the females had recently deposited their eggs. The water in the runnel which drained some shallow peaty headwater pools was 66°F considerably warmer than the water in the shaded lower reaches of Grand Ruisseau. The length-frequency distribution of the sample is given in Table 3 together with a sample of adult *P. pungitius* taken at station 3 in Nibisipi River on July 16, 1962. By July 16, 1962 young of the year ninespine sticklebacks had attained lengths of between 18 mm and 25 mm in Nabisipi River, (sample of 9).

Apeltes quadracus (Mitchill), FOURSPINE STICKLEBACK

Stations:1, 2, 9e. *Collection*: ROM 22729. This species was recorded from three locations in 1961 but in spite of intensive collecting in the same places in 1962 no speci-

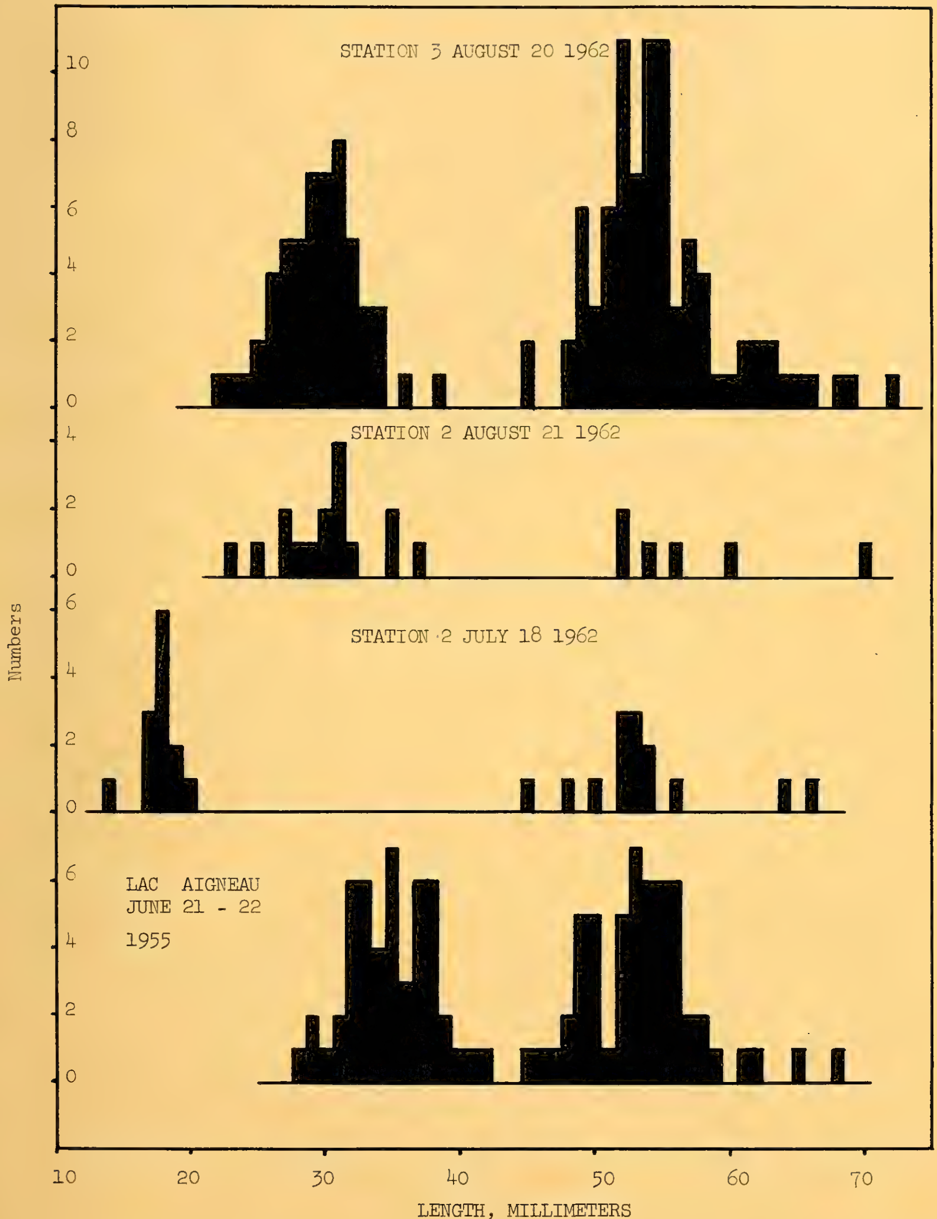

FIGURE 4: The fork length-frequency distribution of a number of samples of *Gasterosteus aculeatus*. Station 3, August 20, 1962, 138 specimens. Station 2, August 21, 1962, 22 specimens. Station 2, July 18, 1962, 27 specimens. Lac Aigneau, June 21-22, 1955, 101 specimens.

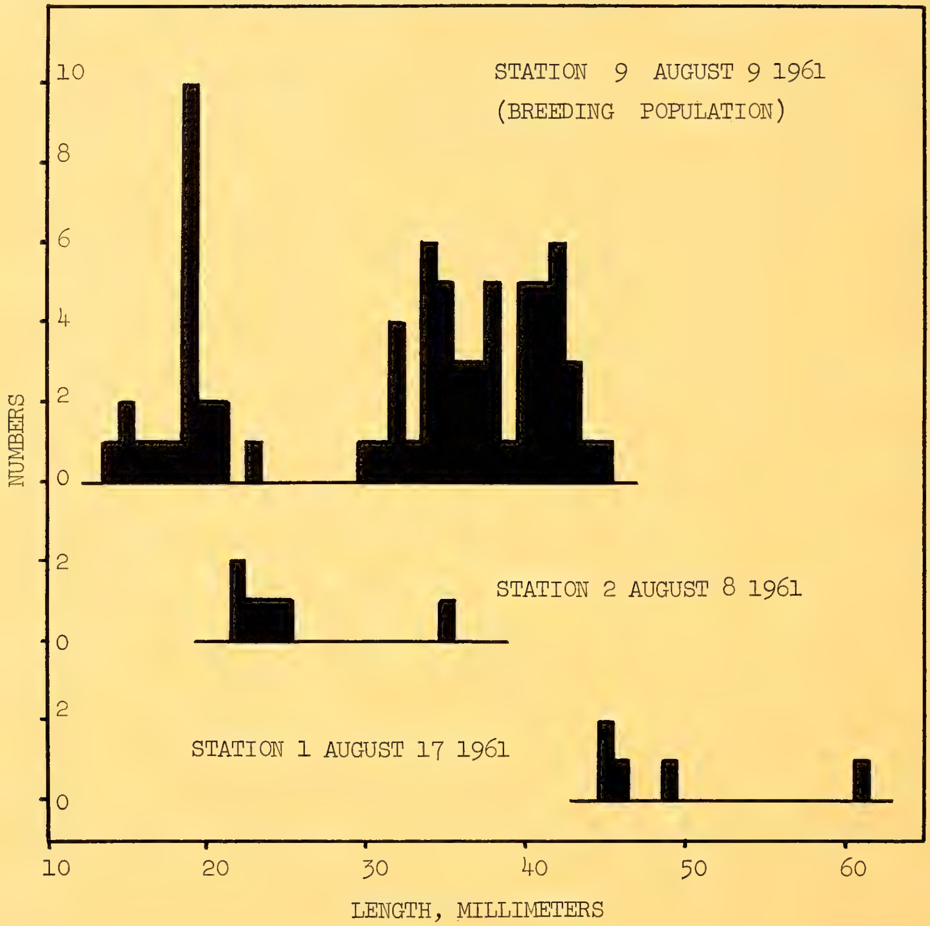

FIGURE 5: The fork length-frequency distribution of samples of *Apeltes quadracus* collected in 1961. Station 9e, August 9, 1961, 72 specimens. Station 2, August 8, 1961, 6 specimens. Station 1, August 17, 1961, 5 specimens.

mens were obtained. One collection of 72 individuals was taken in a tributary of the Aguanus River, station 9e. The fish had bred here in the emergent grass mat at the side of the river. Examination of the length-frequency distribution of this sample, Figure 5, reveals two peaks. The first represents young of the year, the second older fish probably in their second and third years. The length-frequency distributions of the other two samples are included in Figure 5. The sample from Nabisipi River includes five young of the year and one older fish. Five older fish were taken in the estuary and these are somewhat larger than the fresh-water forms.

AMPHIBIANS

While no serious attempt was made to collect amphibians, a few were taken accidentally while fish collecting and others were collected casually when they were observed.

Eurycea bislineata (Green), TWO-LINED SALAMANDER

Collection NMC 7023, 7024. The Two-lined Salamander is probably uncommon in this region, it is not known to local inhabitants. Larvae were collected in only one locality 50° 33′ N, 62° 15′ W in Nabisipi River. One specimen was taken while collecting fish fry on the night of July 15, 1962 in gravel shallows at the foot of the 36 foot falls at this point in the river. Eight specimens were taken the next day while sweeping for fish in aquatic vegetation growing in the bed of the river above these falls. Body lengths, measured from snout tip to posterior angle of the vent, were: NMC 7023 25.0 mm (15 July); NMC 7024 14.5, 19.0, 25.0, 27.0, 27.0, 28.0, 29.0, 29.0 mm (16 July). Total lengths, snout to tail, were 24 and 33 mm for the smallest specimens and between 46 and 56 mm for the remainder excepting one specimen with deformed tail.

Bufo americanus Holbrook, AMERICAN TOAD

Collection: NMC 7032, 7033. The American Toad is sparsely distributed in the area. Two specimens were obtained, one on July 16, 1962 in a small temporary pool at the edge of Napisipi River at 50° 33′ N, 62° 15′ W was 48 mm from snout to the posterior of the ischial protruberance (body length); the second on the east bank of Nabisipi estuary in August 1962, was 58 mm in body length. Other specimens were observed but not collected.

Rana septentrionalis Baird, MINK FROG

Collection: NMC 7025, 7026, 7027, 7028, 7029. This is possibly the commonest amphibian in the area. One adult, 51 mm body length was taken July 8, 1962 at the edge of Lac Saumer 51° 18′ N, 62° 51′ W. One adult, 63 mm, and four tadpoles, total length 30 to 51 mm (stages 26, 27, 30, 31; by tables in Gosner, 1960) were taken above the falls at 50° 33′ N, 62° 15′ W in Nabisipi River on July 16, 1962. One adult 83 mm and numerous young were taken on the same date below these falls in a pool which is some 200 feet back from the river but is quite large and permanent. It is flushed out perhaps every spring but certainly during heavy flooding. The young were of two sizes. One group had only recently hatched but unfortunately the specimens were lost. The other group was in the process of metamorphosis. The mean body length of 19 tadpoles with very small hind limb buds was 56.6 mm, range 42 to 69 mm, S.D. 6.9 The stages by tables in Gosner (1960) were 30 (3), 31 (4), 32 (5), 33, 34, 35 (3), 36, 37. One specimen (in stage 41) with hind limbs and front limbs just about to erupt was 84 mm. Four specimens (stages 42 (3), 43) with back and front limbs had a mean body length of 87.5 mm, range 78 mm to 92 mm. One specimen (stage 45) almost completely metamorphosed was 37 mm in body length.

Rana pipiens Schreber, LEOPARD FROG

Collection: NMC 7030. One specimen 43 mm body length was taken in a small lake near Aguanish June 19, 1962, 50° 14′ N, 60° 08′ W.

Rana sylvatica Le Conte, WOOD FROG

Collection: NMC 7031. One specimen 45 mm body length, very thin and emaciated, was taken in August 1962 on the east bank of Nabisipi estuary.

REPTILES

Thamnophis sirtalis (Linnaeus) EASTERN GARTER SNAKE

Only one reptile, the Eastern Garter Snake, penetrates into this region and it is of rare occurrence. One specimen was taken in 1962 at 50° 23′ N, 62° 10′ W by Yvon Russel, a biology student from Laval University, who was working at the station. The snake was approximately two feet in length. Bleakney (1958) records a specimen taken near the mouth of the Natashquan River in the same general vicinity.

Discussion

Several range extensions are recorded in this paper, which reflect on the lack of previous collecting in the area and the fact that it is partly a matter of chance whether a rare species is found or not. Some of the records could have been predicted. For example that of *Eurycea bislineata* which no doubt, with more careful searching, could be found in other localities along the coastal plain of the North Shore of the Gulf of St. Lawrence in Bleakney's (1958) Herpetofaunal Section 5.

Some species live a marginal existence in this general area and their numbers and ranges may vary greatly from year to year. The Garter Snake and perhaps some of the fish fall into this category. The lake chub, *Hybopsis plumbea*, appeared quite plentiful in the Aguanus River in 1961 but none were seen or taken in 1962. Other species reach the limits of their range in this area and the limits may vary from year to year. Both *Apeltes quadracus* and *Gasterosteus wheatlandi* reach the northern limits of their range in this area. Both were taken in 1961 but neither appeared in 1962 which was a slightly cooler summer. Mean July temperature at Sept Iles was +0.5°F above normal in 1961, but −3.0°F below normal in 1962 (Monthly records of meteorological observations, Canada Department of Transport, Sept Iles). McAllister (1960) published the first records of *G. wheatlandi* from the Province of Quebec and his northern most record is from the Gethsemanie River about 60 miles to the east of Nabisipi River.

The record of *Percina caprodes* from the Aguanus River is most unexpected. As far as I can ascertain its previously known range extended down the St. Lawrence valley only as far as Lac St. Pierre some 600 miles to the west. However, it could have been accidentally introduced into the Aguanus River by anglers (it is a popular bait species).

There appear to have been two routes of entry for freshwater fish recolonizing the Quebec-Labrador peninsula following the last Pleistocene glaciation. Those species that could tolerate brackish or salt water have migrated round the coast recolonizing new watersheds as the habitat became suitable. They then moved up the watershed as far as was physically possible. The distribution of fish in the Nabisipi watershed illustrates the result of this very nicely. In the estuary ten potentially freshwater fish are found. *Acipenser oxyrhynchus* is missing above the estuary and fifteen miles above this *Catostomus catostomus*, *Apeltes quadracus* and *Anguilla rostrata* disappear. In Lac Michaud which is separated from the river by some falls only three species have been found, *Gasterosteus aculeatus*, *Salmo salar ouananiche* and *Salvelinus fontinalis.* Above the 36 feet high falls 30 miles from the coast only *Coregonus clupeaformis*, *S. salar*, *S. fotinalis*, *G. aculeatus* and *P. pungitius* have been found. In Lac Saumur, one of the headwater lakes apparently only *S. fontinalis* occur. Other species have followed an inland route moving up the watersheds of the Saguenay and Lake St. John and into the interior of the peninsula. From there they have moved in all directions as opportunities were presented as a result of headwater capture and other changes in drainage. The two minnows, *Hybopsis plumbea* and *Rhinichthys cataractae* are good examples of this kind of dispersal. Both occur in Koksoak and Whale Rivers draining

northwards into Ungava Bay (Power and Oliver, 1961), and also in the Hamilton and Naskaupi Rivers draining east into Lake Melville on the Labrador coast (Backus, 1957). Both species occur in rivers draining into the Gulf of St. Lawrence although there appears to be no records of *Rhinichthys* east of Saguenay County. *Rhinichthys* may also be absent from the interior of the peninsula at the present time. It was not found there by Munroe (1949), McAllister and Bleakney (1958), Harper (1961) or Power and Oliver (1961), but it could have been overlooked. If it is indeed absent from the interior at the present time the Ungava and Labrador populations must be relict groups that have survived from the period of the climatic optimum 4,000 - 6,000 years ago when the fish was distributed throughout the peninsula. The two regions it is recorded from at the present time are areas where the climate is particularly favourable. Its situation is then akin to that of the salamander *Ambystoma jeffersonianum* [=*A. laterale* in this context] and the frog *Rana pipiens* which occur as relict populations in the Lake Melville area of Labrador (Bleakney, 1958).

Percina caprodes must have followed an overland dispersal route to enter the Aguanus River since it now appears to be absent in the interior. It is perhaps an example of a species that dispersed southwards and now survives as a relict in some of the larger watersheds draining into the Gulf of St. Lawrence. It would be interesting to know if this species occurs in the Natashquan River which has a bigger watershed than the Aguanus River and presumably there would be a proportionally greater chance of entry into the system.

The lack of sculpins is perplexing. They can tolerate brackish water well, they occur in the Ungava drainage and in the Lake Melville drainage. They are almost certainly absent in the Nabisipi River and probably also in the Aguanus River. The habitat appears suitable and a number of rotenone collections were made specifically to try to find sculpins. I can offer no explanation for their apparent absence.

With the present knowledge of distribution it would be unwise to do more than just suggest these possibilities. A fish that is rare may or may not be found. Its absence from a collection does not mean it is absent from the region, only positive records can be taken as fact.

ACKNOWLEDGMENTS

I would like to thank Robert Bourassa, Director of Tourism, Province of Quebec, for arranging my stay at the Nabisipi Research Station and Francis R. Cook of the National Museum of Canada for his advice and assistance with the amphibian data.

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APPENDIX

List and brief description of collecting stations and methods of collecting.

STATION 1: Estuary Nabisipi River
50° 14′ N, 62° 13′ W

This is a fiord-type estuary with steep rocky sides for the most part with sand beaches in sheltered coves and near the sea. Its head is marked by falls 40 feet high and a bar in the river mouth which has a maximum depth of 6½ feet at mean water level marks the other extremity. It is 3,000 yards long and averages 425 feet wide and 15 feet deep. At the foot of the falls, freshwater from the river becomes mixed with saline water in the estuary and creates a surface current of low salinity that is evident at all phases of the tidal cycle. Salinities increase with depth so that at the foot of the falls a salinity of $5^{0}/_{00}$ is reached at 10 feet, $15^{0}/_{00}$ at 15 feet and $25^{0}/_{00}$ at 20 feet. Opposite the research station which is 500 yards from the open sea the salinity is $5^{0}/_{00}$ just below the surface, $15^{0}/_{00}$ at 5 feet and $25^{0}/_{00}$ at 12 feet. The average amplitude of the tide in the estuary is 4 feet. During the summer there is a well marked thermal stratification corresponding with the changes in salinity. Temperatures at the surface are between 15°C and 18°C but fall to between 4°C and 8°C at the bottom. The water is generally clear except following heavy rains when it becomes quite turbid. Collecting in the estuary was done with seines, gill nets and a trap net.

STATION 2: Lower thirty miles Napisipi River
50° 16½′ N, 62° 10′ W
to 50° 33′ N, 62° 15′ W

The first ten miles of the river consists of a series of slow flowing almost lake-like sections separated by falls or severe rapids. The bottom is largely mud or silt except in the falls and rapids where it is bare rock and boulders. Above this is a 15 mile stretch of slow flowing water which is generally shallow, i.e. less than 3 feet, but which contains a number of deeper holes. The bottom is of mud or silt with rooted aquatic vegetation along the sides. Finally there is a reach of shallow moderately swift water which extends to the foot of a 36 ft. high falls. The bottom here is of gravel but silting occurs where possible. There is a high density of pelecypod molluscs in this part of the river. Collecting was by means of day and night seining, lantern and hand seine at night, and rotenone.

STATION 3: Nabisipi River above the 30 mile falls
50° 35′ N, 62° 15′ W

Only the first few miles above the falls was investigated. The river changes character here, the bottom is of clean round gravel, the current is moderately swift and there is only a slight amount of silting. In general it is shallow but there are deeper pools where the water is over six feet deep. Collecting by dipnet and rotenone.

STATION 4: Tributary stream entering Nabisipi Estuary East Side
50° 14′ N, 62° 13′ W

Small stream heavily overgrown by alder shrub about 6 feet wide and 1 foot deep. Bottom very loose and soft and covered with one to two feet of organic debris. Stream passes through a small pond (Lac

Sale) which on the highest tides is flooded with surface water from the estuary. Sampled with rotenone.

STATION 5: Tributary stream entering Lac Michaud 50° 34′ N, 62° 09′ W

Small stream, 30 to 35 feet wide, 1½ to 3 feet deep. Bottom of clean gravel, water clear, under cut banks in places with tree roots and fallen trees providing protective cover. Tree growth on either bank providing some shade. Current moderate. Stream empties into Lac Michaud which overflows via the Michaud River into the Nabisipi River 25 miles above the estuary. Branch of stream sampled with rotenone.

STATION 6: Lac Jerome 50° 46′ N, 62° 22′ W

Lake which drains into the Nabisipi River via a small river some 55 miles from the coast. Approximately 3½ miles long by 1 mile wide. Altitude 500 feet above sea level. Sampled by overnight gill-net set.

STATION 7: Lac Saumur 51° 16′ N, 62° 49′ W

Lake in the headwaters of Nabisipi River. Approximately 4 miles long by 2 miles wide. Altitude about 1,500 feet above sea level. Water very clear, bottom of sand, rock and gravel. Water temperature on July 9, 1962 was 16°C at the surface. Sampled by overnight gill-net set.

STATION 8: Tributary of Lac Saumur 51° 18′ N, 62° 50′ W

Small stream entering from the north. Ten to twenty feet wide and 1 to 3 feet deep. Current moderately swift, water clear, bottom of gravel and stones, banks undercut in places. Two hundred yards above the lake the stream bed constricts down to a few feet and here the bed is overhung by trees and the gradient greatly increased. Rotenone collection.

STATION 9: Aguanus River

A large river five miles to the east of Nabisipi River with general characteristics similar to that river, except that sand is a much more extensive bottom material. A number of collections using rotenone were made in the lower reaches of this watershed.

STATION 9a: 50° 31′ N, 62° 05′ W

Pools in the sand at the edge of the river and small branches of the river (2 feet wide) cutting through rocks at the head of the gorge. The gorge 5 miles above the sea is approximately a mile long and here the river is constricted into a cleft in the rock which at its narrowest point is only about 15 feet across. The current through the gorge is so heavy that according to local information, salmon are unable to ascend it although there are no severe falls in its length.

STATION 9b: 50° 31′ N, 62° 07′ W

Pool in branch of river below gorge. Thirty feet wide 0 to 3 feet deep and 60 feet long. Bottom of rock and gravel. Current almost negligible at time of collection, but would be heavy in periods of higher water.

STATION 9c:

Pool in branch of river below gorge. Bottom rock, current zero at time of collection, but pool flushed during spring floods. Thirty feet by 18 feet, 0 to 3 feet deep, overhanging rocks along one side, water very clear.

STATION 9d:

Small creek entering west bank of Aguanus River immediately below gorge. Four feet wide, depth to one foot, current moderate, bed of rocks and rotting logs covered with brown slimy growth. Overhung by surrounding trees and permanently shaded.

STATION 9e: 50° 31′ N, 62° 08′ W

Tributary entering the west bank of the river one mile above town of Aguanish. Collections were made in an area of emergent reed along the side of the tributary ½ a mile above confluence with main river. Bottom of soft mud depth 0 to 3 feet. Water slightly cloudy.

STATION 10: Grand Ruisseau (Local name)

This is a stream, 7 miles long, which enters the sea one mile east of the Nabisipi River. Near the sea it averages 25 feet wide and 9 inches deep. The bottom is of sand and decaying logs. There are numerous patches of filamentous algae. The water is brownish and slightly cloudy particularly after rain. The temperature seldom exceeds 12° C. Above this the stream is densely overgrown by alder and overhung by surrounding trees. The gradient increases and there are numerous small riffles. The bottom is varied with stones, gravel, sand and partly de-

cayed organic matter predominating. Rotenone collections were made at four points.

STATION 10a: 50° 14′ 30″ N, 62° 12′ W
Lower reaches near the coast.

STATION 10b:
Headwaters of the eastern branch. This branch originates in a flat peat covered plain which is dotted by numerous small ponds. One of these ponds drains into Grand Ruisseau via a small runnel 1 to 2 feet wide and approximately 9 inches deep. The sides of the runnel are of peat and the bottom of sand and peat.

STATION 10c:
Small headwater stream which empties into a small lake draining into the western branch of Grand Ruisseau. Stream is 3 to 4 feet wide, 0 to 1 foot deep and heavily overgrown by alders except for about 100 yards or so before it enters the lake. Here it cuts through the peat and is deeper and broader as it meanders into the lake.

STATION 10d:
Pools in a rocky promontory at the mouth of Grand Ruisseau. The rock has weathered so that numerous small pools, triangular in cross section have been formed at various levels above the sea. At the top of the promontory the pools contain fresh rain water, but lower down the shore they contain increasing amounts of sea water. The pools are exposed and in hot clear weather must experience considerable temperature fluctuations. In winter they are probably frozen throughout. They form a temporary habitat for certain marine fish trapped by the tide and a breeding place for *Gasterosteus aculeatus*.

STATION 11: Ruisseau Rundel (Local name)
50° 15′ 30″ N, 62° 14′ W
Small stream half a mile to the west of Nabisipi River. Total length about one and a half miles. Near the sea it is 2 to 4 feet wide and a few inches deep. Valley is overgrown with a dense growth of alder which provides complete shade. Current is moderate and bottom of gravel, sand and partly decayed vegetation. Water is clear. Rotenone collection.

STATION 12: 50° 16′ N, 62° 16′ W
Small stream one and a half miles to the west of Nabisipi River. The estuary, which runs parallel to the shore behind sand dunes, is long and extensive. Above this the stream constricts to 10 to 15 feet wide, has an average depth of one foot and a bottom of rock and boulders in the region investigated. Complete shade is provided by overhanding trees and there is a rich growth of filamentous green algae on the rocks and stones. The current is moderate to swift, the water clear. Rotenone collection.

Received for publication 18 May 1964

REPORT OF COUNCIL TO THE EIGHTY-SIXTH ANNUAL MEETING OF THE OTTAWA FIELD-NATURALISTS' CLUB

December 8, 1964

During the past year, five meetings of Council were held at the National Museum of Canada: December 12, 1963, March 11, June 2, October 15 and November 24, 1964. The average attendance was fourteen members. The Club's business was conducted in the usual orderly manner.

Appointments for 1964 were made as follows:
Editor, The Canadian Field-Naturalist — F. R. Cook
Business Manager, The Canadian Field-Naturalist — W. J. Cody
Chairman, Publications Committee — D. D. Hogarth
Chairman, Excursions and Lectures Committee — P. H. Jones
Chairman, Reserve Fund Committee — H. Lloyd
Chairman, Membership Committee — F. H. Schultz
Chairman, Bird Census Committee — G. H. McGee
Chairman, Macoun Field Club Committee — A. H. Clarke, Jr.
Chairman, F.O.N. Affairs Committee — R. Frith
Chairman, Public Relations Committee — No appointment
Chairman, Preservation of Natural Historic Sites
Committee — W. K. W. Baldwin
O.F.N.C. Representative to A.A.A.S. Council — V. E. F. Solman

Report of the Excursions and Lectures Committee

Since the last report of Council, three numbers of The Canadian Field-Naturalist have been published. These included the last number of Volume 77 which contained 64 pages and the first two numbers of Volume 78 which contained 130 pages, or a total of 194 pages in all. Papers, notes and reviews were distributed as follows:

	Papers	Notes	Reviews
Botany	7	1	1
Entomology	0	1	1
Geology	1	0	1
Herpetology	1	3	0
Ichthyology	0	2	1
Mammalogy	4	1	1
Ornithology	7	8	4
Miscellaneous	2	0	8
	22	16	17

The editor has reported that Volume 78 Nos. 3 and 4 will be published shortly. Adequate manuscripts are on hand for at least the first two numbers of Volume 79.

Expenditures for the year were as follows:

Volume 77 (No. 4) and 78 (Nos. 1 and 2)	$3,163.25
Reprints for Volumes 76 (Nos. 2, 3 and 4) and 78 (1)	909.27
Total	$4,071.52

The publication of THE CANADIAN FIELD-NATURALIST was materially assisted this year by a grant of $500 from the Conservation Committee of the National Sportsman's Show. This assistance is gratefully acknowledged.

REPORT OF THE EXCURSIONS AND LECTURES COMMITTEE

The Excursions and Lectures Committee met four times during 1964 and arranged a varied programme which included ten well-attended bird outings (not including the Christmas Bird Census and a Woodcock count), an evening frog outing, a trip to Jones Falls, near Kingston, to study spring flowers and a mushroom excursion in September. The Committee organized visits to the Montreal Botanical Gardens and Point Pelee but cancelled both excursions for lack of interest. Five Newsletters were issued. Mr. George McGee conducted a successful series of winter bird identification lectures.

The Committee arranged the annual dinner at the Experimental Farm and heard an interesting talk entitled "Prescribed Forest Fires" given by Mr. J. C. Macleod of the Department of Forestry.

At its final meeting the Committee discussed a program for 1965 which would help stimulate greater participation and interest in club activities. It considered also the desirability of appointing conveners for the major branches of natural history each of whom would serve as a focal point for excursions and study.

REPORT OF THE RESERVE FUND COMMITTEE

In April, eight additional shares of Bell Telephone Stock were purchased at $38.00 per share. With purchase of additional rights and brokerage, the cost amounted to $402.50. Our total holdings are now 28 shares of Bell Telephone Stock and $3,000 in Ontario Hydro 3% Bonds.

REPORT OF THE MEMBERSHIP COMMITTEE

The Committee distributed information on Club activities and solicited new members. Sixty-nine new memberships were added, bringing the total membership in the Club to 766.

The new members included 36 active, 11 associate and 22 institutional. The membership now consists of:

Active — local — 181	
— other — 246	427
Associate	42
Institutional	277
Honorary	4
Life	8
Affiliated Societies	8
Total	766

REPORT OF THE BIRD CENSUS COMMITTEE

The Ottawa Field-Naturalists' forty-fifth consecutive annual Christmas Bird Count was held on Sunday, December 22, 1963. A total of 5,893 birds of 52 species was reported, compared with 5,375 birds of 45 species last year. The number of individuals is slightly lower than the average over the past ten years. However, the number of species constitutes a new record and is well above the ten year average of 40. No new birds were added to our all-time list of 80 species. A total of 47 observers in 13 parties participated in the count.

Details of the census were published in Audubon Field Notes. In addition the results were included in the January Newsletter and made available to the Kitchener-Waterloo Field Naturalists' Club for inclusion in a report consolidating the observations of some 20 Clubs in Ontario.

The Committee met informally many times during the spring months in connection with the preparation of an up-to-date list of birds that have been recorded in the Ottawa area. The list was published with the approval of Council in the conventional pocket size form under the title of "Field Checking List of Birds 1963". Copies are available at a nominal price through the Business Manager and at the National Museum. This new list is based on Lloyd's "The Birds of Ottawa 1944" with additions and follows the AOU check-list (Fifth Edition 1957) for names and arrangement. The species listed have been recorded within thirty miles of the National War Memorial.

REPORT OF THE MACOUN FIELD CLUB COMMITTEE

Retirement of A. H. Clarke, Jr. as Chairman of the Club in the fall was a distinct loss which would be felt even more seriously but for changes during his tenure of office. A more official administrative relationship with the National Museum, and assignment to it of two of its staff, Mr. A. A. Ellis and Mr. G. Tessier, and more recently also of Mr. S. D. Macdonald, has added stability.

Promotion of membership no longer is necessary. Even with the present roomy quarters a waiting list has become necessary, from which to draw as members graduate or withdraw for other reasons. Limitation to thirty or forty in a meeting is necessary in the interest of order and good hearing. This attendance is reached except in the High School group which has about fifteen.

The senior group, meeting on Friday after school, enjoys talks, often illustrated with slides by specialists, and by its members. Various individual and group projects are under way. The other two age groups, meeting in turn on Saturday forenoon, also hear outside speakers, but on alternate weeks largely provide their own program by speaking about specimens or collections brought from home. This is an interesting development from former mere observations; and as determined by popular vote, gains credits toward the badge, if not already won. A bull's eye chart records progress. Indoor meetings continue throughout the winter, with field trips in autumn and spring, before disbanding for the summer. The fifteenth annual birthday party, to which parents and friends were invited, was the opening event in the fall of 1964, at which time also the Club's publication, the Little Bear, was distributed.

Elections resulted in selection of the following Presidents, with supporting officers: Senior, John G. Robertson; Intermediate, Phillip Ward; Junior, Bruce Couzens.

The Club was represented at the annual dinner of the Field-Naturalists' Club, its co-sponsor, with an exhibit of its work. Mr. Herbert Groh continues his role as Editor of the Little Bear. His records of the Club members become of absorbing interest as these pass, in many cases, through University and out into creditable careers. The O.F.N.C. may be proud of its continuing part, financially and in personnel, in this worthy work.

REPORT OF THE F.O.N. AFFAIRS COMMITTEE

No official joint activities of the F.O.N. and the Ottawa Field-Naturalists' Club were held in 1964. A small group of members including the President of O.F.N.C. attended the Federation gathering at Point Pelee National Park on May 9 and 10, 1964.

Sales of 64 dozen 1963 Federation Christmas cards gave the O.F.N.C. a net return of $16.00. Sale of 1964 Christmas cards is in progress at rate of this report.

REPORT OF THE PUBLIC RELATIONS COMMITTEE

This Committee was not active during the year.

REPORT OF THE PRESERVATION OF NATURAL HISTORIC SITES COMMITTEE

No Committee meetings were held this year. The site of chief interest now is the Mer Bleue. The National Capital Commission is currently considering our proposals on this site.

A. W. RATHWELL, *Secretary*

BIRD CHECKING LIST

Single copies of the **Bird Checking List of the Ottawa Area** may be obtained at 1c each from:

The Excursions and Lectures Committee,
The sales desk at the National Museum of Canada,
McLeod and Metcalfe Streets.

Lots of 100 are available at $1.00 + 20c postage from:

The Business Manager, W. J. CODY,
Canadian Field-Naturalist,
Plant Research Institute,
Central Experimental Farm, Ottawa, Ont.

STATEMENT OF FINANCIAL STANDING
THE OTTAWA FIELD-NATURALISTS' CLUB NOVEMBER 30, 1964

CURRENT ACCOUNT

Assets

Balance in Bank 30 Nov. 1964	$3,729.87
Bills Receivable	624.82
	$4,354.69

Liabilities

NIL

Receipts

Balance in Bank 27 Nov. 1963		$2,590.76
Fees:		
Current	$3,094.10	
Arrears	210.00	
Advance	259.80	
Associate	96.00	
		3,659.90
Separates & Illustrations		1,320.79
Sale of Back Numbers		464.23
Geology of Ottawa District		94.50
Geology of Gatineau-Lievre		25.00
Field Checking List-Birds		18.25
Macoun Field Club Collection		40.25
Donation — Sportsmen's Show		500.00
Miscellaneous		106.67
		$8,820.35

Expenditures

Can. Field-Naturalist 3 Nos.	$3,039.53
Separates & Illustrations	1,033.99
Field Checking List of Birds	125.76
Editor's Honorarium	200.00
Business Manager's Honorarium	100.00
Bookkeeping	100.00
Excursions & Lectures Comm.	49.63
Macoun Field Club	150.00
Postage & Stationery	171.74
Bank Discount	28.50
Miscellaneous	91.33
Bank Balance 30 Nov. 1964	3,729.87
	$8,820.35

RESERVE FUND

Assets

$3,000 Ontario Hydro 3% Bonds, market value	$2,792.50
28 Shares Bell Telephone Stock, market value	1,708.00
Balance in Bank 30 Nov. 1964	150.59
	$4,651.09

Liabilities

NIL

Receipts

Balance in Bank 27 Nov. 1963	$ 411.43
Bank Interest	3.86
Ontario Hydro Bond Interest	90.00
Bell Telephone Dividends	52.80
	$ 558.09

Expenditures

8 Shares Bell Telephone Stock	$ 402.50
Safety Deposit Box	5.00
Bank Balance 30 Nov. 1964	150.59
	$ 558.09

PUBLICATIONS FUND

Assets

$1,500 Ontario Hydro 3% Bonds, market value	$1,383.75
5 Shares Bell Telephone Stock	305.00
Balance in Bank 30 Nov. 1964	78.53
	$1,767.28

Liabilities

NIL

Receipts

Balance in Bank 27 Nov. 1963	$ 292.97
Bank Interest	2.76
Ontario Hydro Bond Interest	45.00
Bell Telephone Dividends	5.50
	$ 346.23

Expenditures

5 Shares Bell Telephone Stock	$ 267.70
Balance in Bank 30 Nov. 1964	78.53
	$ 346.23

Audited and found correct (Signed)
J. M. Gillett and R. J. Moore, Auditors

(Signed) Anne Banning, Treasurer

REVIEWS

The Natural Geography of Plants

By Henry A. Gleason and Arthur Cronquist. Columbia University Press, New York, and Copp Clark Publishing Co., Toronto. 1964. 420 pp. $10.00.

In this excellent book the authors present a fascinating picture of the floristic provinces of North America, their intergradations, the origins of the plants characteristic of each province, and the factors that control the present distribution of these plants. The book is copiously illustrated with excellent photographs, finely reproduced, of habitats and individual plants. The illustrations, from many sources, but notably the United States Forest Service, occupy about half the book. The text is thus quite short, but it is packed with information.

The approach is predominantly ecological, and it is notable that the authors, writing primarily for the amateur naturalist, have been able to present their points clearly and concisely without the complex vocabulary that many ecologists consider essential. Only in presenting a modification of Raunkiaer's classification of life forms do they introduce any complexity; and here their explanations take more space than a discussion in plain English need have done.

In a brief coverage of so large a field some generalizations are inevitable; and, despite evident care, brevity has led to the inclusion of some statements that may mislead the unwary. We have considerably more information on postglacial migration rates (and posthypsithermal retreats) than is suggested on page 81. The factors limiting tree growth at the arctic tree line are much more numerous and complex than merely adequate temperature for an adequate time as indicated on pages 99 and 202. The discussion of speciation (p. 113) is very superficial, with inadequate emphasis on the importance of physical isolation in allowing variants to reach the species level. Hybridization certainly does produce some new species, but the parents must first speciate in isolation. There are many exceptions to Jordan's law (p. 123), or the competitive exclusion principle, in severe ecological conditions, especially in the high arctic where several species of a genus may be seen in a square meter of uniform ground. Dr. Gleason's apparent preoccupation with the spread of seeds on birds' feet has caused him to neglect other, generally more effective, means of long-range dispersal; and some of his examples are unfortunate. Thus *Butomus umbellatus* is spread predominantly by aquatic means. Although *Endothia parasitica*, the chestnut blight pathogen, was isolated from the feet and plumage of birds collected from cankered trees, birds were never implicated as significant vectors. The conidia are splashed by rain, and the ascospores, after forcible discharge, are carried by wind. The steady radial spread from the site of introduction was typical of wind dispersal and unlike the random occurrence associated with bird vectors.

A few factual errors have crept in, which may be pointed out in view of the likelihood of such a valuable book undergoing revision. *Epilobium angustifolium*, which sprang up in bombed areas of London is, of course, as much a European as a North American plant, and there is no mystery in its occurrence on such sites. Moreover every British plant examined has proved to be diploid, like the rest of the European population. The temperate population in North America is tetraploid and only the subarctic and subalpine plants are diploid, as Dr. Mosquin has shown. It is stated (p. 206) that the forest advanced into the prairie at the end of the hypsithermal period (or xerothermic as the auth-

ors, like many other botanists but no zoologists or glaciologists, call it), and that the Indians started burning the grass later, perhaps 5000 years ago; but the hypsithermal ended about 3000 years ago. Inevitably the authors are less well informed about the arctic than the floristic provinces in which they have worked. The last plants do not vanish among bare rocks, ice and snow as one travels north. When the northernmost land is reached at 83° North, there are still a substantial number of species; and more than 100 species occur at a single site at 82° North. It is only on the very flat, gravelly western shores, some 300 miles further south, that, in the last mile or so, one may leave all plants behind. The whole of the tree line in Canada is shown on air photographs; and only the complexity of the floristic boundary, not lack of exploration, makes its position on the map uncertain. Sphagnum is common only in the low arctic, and absent from many islands. Although much of the arctic is a wet desert, some parts are extremely arid, supporting little but scattered bunchgrasses with tightly involute leaves.

Such small errors detract very little from the book, which will add greatly to the pleasure and profit that any naturalist gets from excursions either close to home or into other floristic provinces.

D. B. O. SAVILE

Plant Research Institute
Canada Department of Agriculture,
Ottawa, Ontario

The Mosses of Michigan

By HENRY T. DARLINGTON. Edited by Howard Crum. Cranbrook Institute of Science, Bloomfield Hills, Michigan (Bulletin No. 47) 1964. pp. I-X, 1-212. Fig. 1-147. 1 map. $12.00.

Students and amateur bryologists will welcome this new book on mosses. The author was in his ninetieth year when he published his manual and he admirably incorporated in his work the pedagogical knowledge and know-how of his prolonged experience as a professor.

Three hundred and ninety-nine species from 125 genera and 43 families are described briefly. Emphasis is placed, whenever possible, on those particular morphological features that can be observed in the field. All the genera, but only one third of the species, are illustrated. However, the author mentions for each species illustrations present in other manuals readily available, such as Conard's *How to Know the Mosses* or Welch's *Mosses of Indiana*. Most of the illustrations, borrowed from Braithwaithe's *British Moss Flora*, are surprisingly well reproduced. Notes following the description of species refer to habitat, general world-wide occurence and geographical distribution within the various counties of the Upper and Lower Peninsulas in Michigan. Students will appreciate the extensive glossary at the end of the volume. This glossary (and the same is true of figure 2 where cell length-breadth ratios are illustrated) would have proved more useful if the author had referred to specific examples from some of the illustrations of his book. Noticeable errors in typography appear extremely rare. It is evident that the editor of this manual, a well-known bryologist, not only devoted much of his time and knowledge to the scientific aspects of this work (such as revising the descriptions and improving the keys) but also spent considerable time planning the material composition as well. A feature one would like to see incorporated in manuals of this kind would be a chapter (or at least a few pages) on ecology. Students are always stimulated when shown in the field the ecological significance of bryological communities and their importance in various phytecenoses.

To this reviewer it was a surprise to learn that only 399 species of mosses had been found in a State so well known bryologically as Michigan. We are certainly more fortunate here in eastern Canada where bryophytes form such an

important part of the vegetation. Nevertheless, this manual should be very useful to students in Ontario and Quebec since most of the species described from Michigan also exist within the confines of our eastern provinces. As a matter of fact, 94 per cent of the species listed in this book have also been collected in Quebec. In our region, sometimes within very limited areas, one will observe a surprisingly great number of bryophytes. For example, on Mount Shefford in southern Quebec, a small granitic hill of less than nine square miles, the reviewer found 42 per cent of the species and 59 per cent of the genera present in the entire State of Michigan.

This new moss flora will be a valuable addition to the library of all professional and amateur botanists. It will also become a life-saving instrument for those who have to teach bryology and do not have available copies of the now classical but unobtainable *Mosses With a Hand-Lens and Microscope* by A. J. Grout.

BROTHER FABIUS LEBLANC, S.C.

Department of Biology
University of Ottawa
Ottawa, Ontario

Birds Over America

By ROGER TORY PETERSON. Dodd, Mead and Company, New York, Second Edition. 1964. XIII + 342 pp., 78 plates. $7.50.

It is a pleasure to note the publication of a second and revised edition of this deservedly popular book, which first appeared in 1948. Extent of the revision is adequate but not drastic. This is as it should be, for the book's contents are as valid and interesting now as they were sixteen years ago. Where necessary, information has been updated to include new findings. References to persons mentioned who have passed on since the first edition came out are changed to past tense. Reproduction quality of the photographs, in my new copy at least, is somewhat inferior to that in the 1948 edition, the new reproductions having lost some of the original crispness and contrast.

"Birds Over America" is filled with useful information, discussion, and speculation, the kind of 'shop talk' that appeals to everyone interested in birds whether 'list hound' or serious researcher. Through all this Peterson skillfully weaves the threads of his own abundant field experience and impressions. The hundred photographs in the book, taken by the author, are mostly outstanding, some superb. The popularity of this reasonably priced volume will doubtless continue for a long time to come.

W. EARL GODFREY

National Museum of Canada
Ottawa, Ontario

Biosystematics of Sibling Species of Flycatchers in the *Empidonax hammondii — oberholseri — wrightii* Complex

By NED K. JOHNSON. 1963. University of California Publications in Zoölogy 66(2): 79-238. 8 plates, 28 text figures. $3.50 U.S.

This obviously painstaking study should greatly facilitate accurate identification of specimens of the three perplexingly-similar species concerned. It was found that wing-tail ratios are intraspecifically different between adults and the category of "juveniles, immatures, and first-year birds". Failure to recognize this has contributed to many of the identification difficulties in the past.

In addition to these important laboratory findings, very useful original data on the ethology, ecology, and songs are presented.

W. EARL GODFREY

National Museum of Canada
Ottawa, Ontario

Fishes Occurring in the Fresh Waters of Insular Newfoundland

By W. B. SCOTT and E. J. CROSSMAN. Canada Department of Fisheries, Queens Printer, Ottawa, 1964, 124 pp., 18 fig. plus photos, col. frontispiece. (Contribution Number 58, Life Science, Royal Ontario Museum). $3.00.

It is a pleasure to open this book on a previously unstudied fish fauna. The sharp photographs of fishes and the lakes and streams they live in appeal to the eye. The endpapers have been made use-

ful by imprinting them with a map of Newfoundland.

Despite its plenitude of lakes and streams Newfoundland is depauperate in its freshwater fish fauna. Only twenty-three species are known, and of these only nineteen are native. None of them is a primary freshwater form, that is all have some ability to traverse stretches of salt water.

The book includes an introductory section; keys to the species; a species account which may include: previous records, distribution, habits, parasites, notes on sport and commercial fishing, a description, and a figure; a brief discussion on zoogeography; tables on collections made by the authors; notes on introduction of fishes; comments on some collection sites and an extensive list of references.

The species accounts are well and interestingly written. Our knowledge of common names is enriched by including such Newfoundland names as "mud and slop trout" for brook charr, and "snig" for the tomcod. The authors have not let themselves be bound by a strict format, so some accounts are more expansive where they have more information.

During the book's long sojourn in press, another study changed the name of the rainbow smelt to *Osmerus eperlanus mordax*. Recent authors (McAllister, 1958 and Richards, Perlmutter and McAneny, 1963) are in agreement that the inshore sandlance should be called *Ammodytes hexapterus* rather than *Ammodytes americanus*. One would have liked to hear more of the authors' views on zoogeography — how the fish got there, when Newfoundland was deglaciated etc. There are slips in the keys such as according the sticklebacks with a pectoral spine, but these are few.

This book should be a stimulus to tourism and to interest in ichthyological studies in Newfoundland, and is a fine addition to books on provincial fish faunas.

D. E. McALLISTER
National Museum of Canada
Ottawa, Ontario

The Insects

By URL LANHAM. 1964. Columbia University Press, New York and London. 292 pp. $6.95 (Canadian distributor; The Copp Clark Publishing Co. Ltd., Vancouver, Toronto, Montreal).

This is fundamentally an introductory textbook of entomology in which the author courts the general reader by limiting the use of scientific names and terms and by assembling an almost overwhelming array of interesting facts about insects. It is a good book, written with authority by one who obviously knows and enjoys his field. The author is associate curator of entomology at the University of Colorado Museum.

The subject is treated in four parts. Part 1, *In Perspective*, identifies the insect and its place in the animal kingdom, and explains insect taxonomy. Part 2, *Form and Function*, enters briefly into the fields of insect morphology and physiology in chapters on external and internal anatomy, the flight mechanism, reproduction and development, and the sense organs and behaviour. Part 3, *Insects and their Environment*, includes chapters on adaptations of insects to climate and to season, on their associations with plants and with animals, on predation and parasitism, and on adaptations of some insects to an aquatic life. Part 4, *The Parade of the Insects*, characterizes and portrays the main orders of insects. An amazing amount of well chosen information is concentrated in the relatively few pages.

The text ends with a short conclusive chapter and is followed by a lengthy bibliographical appendix. The appendix lists books and scientific papers that might well comprise the reference library of a professional entomologist. It seems somewhat out of place in a book of this sort but is certainly worthwhile for anyone spurred to serious study. It includes one error that is repeated in the index — R. W. Walt should read R. W. Salt. The illustrations are rather disappointing. The photographs are not of high quality, and

the line drawings do not enhance the text as much as they should.

JOHN W. ARNOLD
Entomology Research Institute
Central Experimental Farm, Ottawa

The Pond

By ROBERT MURPHY. Illustrated by Teco Slagboom. E. P. Dutton and Co., Inc. New York. 1964. 254 pp. 5.75.

This is the 1964 winner of the Dutton Animal Book Award; the first was the deservedly successful *Rascal* (see Canadian Field-Naturalist 77(4):230). The latest choice has many of the qualities of the first — a thoroughly likable boy and the same nostalgic time and setting for growing up (the early nineteen hundreds) which bring back a way of life and an abundance of wilderness rapidly being lost in our modern era of intense population growth and organization.

The boy, Joey, is followed through a couple of all-too-short vacations away from his parents at his father's hunting lodge. These experiences rapidly mature his attitudes toward wildlife and people. The first boyish thrills of the hunt are well portrayed — so much so that the emphasis on killing seems to remain dominate despite an eventual change in attitude in the hero. One incident in the story, that of Mr. White and the schoolteacher, is perhaps unnecessarily mature material for the intended audience, though many youthful readers will presumably be more-or-less innocent of the implications.

Despite the book's qualities as a "boy story" with a nature setting, I cannot regard it as a suitable animal book award winner. The publishers too obviously searched manuscripts for a book of the Rascal "formula" but missed the point. The animals here are background instead of central theme importance. Another by-product of the attempt to exploit Rascal's success is a price explosion in the cost of a volume of the series from $4.50 to $5.75.

FRANCIS R. COOK

The Fields of Noon

By SHEILA BURNFORD. Illustrated by Cécile Curtis. McClelland and Stewart, Toronto and Montreal. 1964. 159 pp. $4.50.

Anyone with even a slight inclination to allow a little emotionalism with their nature and pet appreciation — and I don't refer to sticky gushiness or bloated awe, but temperate dilutions of humour and pathos — will find this slim volume thoroughly satisfying reading. The author, now well entrenched in her own and Disney-made glory from her first book "The Incredible Journey" portrays here a few brief glimpses of personal experience. Some of the chapters, each a self-contained unit, have previously appeared on the pages of the *Atlantic, Macleans, Punch, Harper's Bazaar* and the *Evening Standard* and the crispness of the short essay approach is retained throughout.

Although I can forgive her totally unscientific chapter on archaeology in its context, I cannot condone the substitution of 'family name' for genus (through error not coyness? — or perhaps for the subtle amusement of some chance scientist) during the explanation of scientific names in the chapter extolling the hunting and eating of mushrooms. Other chapters give brief instances of spring, walking, bird-calling and pets — cat, canary, persistent retreiver and aging terrier. They are all portrayed as vividly as the author's personality is revealed.

FRANCIS R. COOK

Many Trails

By R. D. SYMONS. Longmans Canada Limited, Toronto. 1963. 202 pp. $5.50.

R. D. Symons was born in England in 1898 and came to western Canada in 1914. This book, his first, is autobiographical and was penned intermittently through the period between 1914 and 1945. It is illustrated, all too sparsely, with the author's sketches which capture its easy style far more ably than could the labours of a commercial artist.

The text retraces the many trails covered by the author — as a ranch hand, a homesteader and a "Provincial Game Guardian" — from the Cypress Hills of Saskatchewan and Alberta to the Chilcotin region in interior British Columbia and back to Saskatchewan to portray the northland of that province as seen in the area to the west of "Le Pas". The material is arranged into sections according to the type of trail taken — cattle, pack, homestead, indian and northern — with a nostalgic introductory chapter on his home life in England.

Throughout, the book is filled with the richness and depth of the writer's outlook and experience; observations of both animals and people are touched by the pioneer's appreciation and love of the unbroken land. His pen breathes life into the Canadian West and it rises in clear images against his flowing monologue style.

The reviewer's copy will inevitably become tattered from years of use as this is a book to be re-read appreciatively innumerable times.

FRANCIS R. COOK

OTHER NEW TITLES

Herpetological Type-specimens in the University of Illinois Museum of Natural History

By HOBART M. SMITH, DAVID A. LANGEBARTEL and KENNETH L. WILLIAMS. The University of Illinois Press, Urbana. 1964. 80 pp. Paperbound $3.00. Clothbound $4.00 (Illinois Biological Monographs 32).

The Origins and Growth of Biology

Edited by ARTHUR ROOK. Penguin Books Ltd. 1964 (Pelican Books A536). 403 pp. Distributed in Canada by Longmans Canada Ltd., Don Mills, Ontario, $1.25.

The Behavior of Heteromyid Rodents

By JOHN FREDERICK EISENBERG. University of California Publications in Zoology 69:1-114. 1963. $2.50 U.S.

The Relationship of Population Density to Endocrine and Metabolic Changes in the California Vole *Microtus californicus*

By R. T. HAULIHON. University of California Publications in Zoology 65(5): 327-362, 9 text figures. 1963. $1.25 U.S.

Collection and Care of Botanical Specimens

By D. B. O. SAVILE. Canada Department of Agriculture. Research Branch Publications 1113. 1962. 124 pp.

A Geobotanical Survey of Northern Manitoba

By J. C. RICHIE. Arctic Institute of North America, Technical Paper No. 9. 1962. 48 pp. + 2 maps.

The Michigan Botanist

Published by the Michigan Botanical Club. Subscriptions: Mrs. Laura T. Roberts, 2120 Washtenaw Road, Ann Arbor, Michigan. Volume 1, Number 1, published March 1962.

The Vascular Plants of Clinton, Jackson and Jones Counties, Iowa

By TOM S. COOPERRIDER. State University of Iowa Studies in Natural History. Vol. 20, No. 5. 1962. 76 pp.

Hibernation in Mammals

By CHARLES P. LYMAN. Arctic Aeromedical Laboratory, Fort Wainwright, Alaska. Technical Report 61-5, Project 8240-25. 1961, 23 pp.

Major Vegetation Types of Western Ontario and Manitoba from aerial photographs

By JAMES A. LARSEN. Technical Report No. 7, Department of Meterology, University of Wisconsin, Madison. 1962.

Vegetation and Soils: A Word Picture

By S. R. EYRE. Edward Arnold (Publishers) Ltd. 324 pp. $6.50.

The International Council for Bird Preservation. C.I.P.O., I.R.V. IX Bulletin

1963. 180 pp. Obtainable from: Treasurer, U.S. Section, Mr. Milton Erlanger, Room 550, 350 5th Ave., New York, N.Y. $2.10.

The Lemming Cycle at Baker Lake, Northwest Territories, During 1959-62
By CHARLES J. KREBS. Arctic Institute of North America, Technical Paper No. 15. 1964. pp. 1-104.

Bird Art in Science
By R. L. SCHEFFEL. New York State Museum and Science Service, Education Building, Albany, N.Y. 1964. 30 pp. $0.50 (remittance to be made payable to N.Y. State Education Department).

Geographical and Sexual Variation in the Long-tailed Jaeger, *Stercorarius longicaudus* Viellot
By T. H. MANNING. Biological Papers of the University of Alaska. Number 7. 1964. 16 pp. $0.50. (Department of Wildlife Management, University of Alaska, College, Alaska).

Fishes of Northern Ontario, North of the Albany River
By R. A. RYDER, W. B. SCOTT and E. J. CROSSMAN. Life Sciences, Royal Ontario Museum, University of Toronto, Contribution 60. 1964. 30 pp. $0.75.

Boissiera
VOLUME 10. Genève et Paris, 1964.
Le genres de Polygonacées. By Guy Roberty and Simone Vautier, pp. 7-128.
Les genres de Convolvulacées (esquisse) By Guy Roberty, pp. 129-156.

NOTES

Further Records of The Four-toed Salamander with Remarks on its Habitat in Quebec Province

THE FOUR-TOED SALAMANDER, *Hemidactylium scutatum*, has only been added to the Quebec herpetofauna recently. Bleakney (1954, Canadian Field-Naturalist 68:165) reported one specimen from Gleneagle, Quebec. Gorham (1955, Canadian Field-Naturalist 69:167) reported nine additional specimens from near Gleneagle, and one specimen from near Kingsmere, Quebec. All these specimens were taken within a few miles of each other in the Gatineau Hills. Denman (1961, Canadian Field-Naturalist 75:110) reported a specimen from Mount Johnson, Quebec, 140 miles to the east.

In October 1963, a *Hemidactylium* was taken by Mr. William Park on Ile Perrot, Quebec, at the junction of the St. Lawrence and Ottawa rivers. It has been donated to the National Museum of Canada where it is catalogued as NMC 8192. This collection site lies 100 miles east of the Gatineau localities and 40 miles West of the Mt. Johnson locality. I have also a sight report, unconfirmed by collection, from near the city of Joliette, Quebec.

The Four-toad Salamander can now be considered as an established member of the Quebec herpetofauna; its cryptic habits and the few local collectors may account for its apparent rarity.

One of the specimens reported by Gorham, a female, was collected in a sphagnum bog. The rest of the specimens recorded and the specimen reported here were all collected in second growth transition forest (type L.2 of Rowe, 1959, *Forest Regions of Canada*, Department of Northern Affairs and National Resources, Forestry Branch Bulletin 123). This forest is dominated by mixed maple, birch, beech, oak, hemlock, and white spruce. In all of these localities the forest floor was dry with considerable exposed bed-rock. The

very limited sphagnum patches present were confined to small hollows usually dry in summer and containing temporary melt-water pools in spring.

NORRIS S. DENMAN
350 William Birks Street
St. Bruno de Montarville, Quebec
20 February 1964

Notes on Manitoba Plants

(1) *The black- and yellow-fruited choke cherries in Manitoba*

The choke cherry is one of the commonest shrubs in Manitoba and its red-fruited form, *Prunus virginiana,* has been frequently collected. It has, however, been a matter of doubt if the black-fruited form, *P. melanocarpa,* was native to this province.

Macoun (1882, *Manitoba and the Great North-West*) notes that "Choke cherries, which in Ontario are extremely astringent, are in the North-West remarkably sweet, and pleasant to the taste." This he attributes to climatic, rather than genetic, differences. Lowe (1943. *List of the Flowering Plants, Ferns Club Mosses and Liverworts of Manitoba*) included the red-fruited form, *P. virginiana,* only but, in a later, undated supplement, reported *melanocarpa* from St. Lazare. Scoggan (1957, *Flora of Manitoba,* National Museum Bulletin 140) notes Lowe's St. Lazare listing but, in the absence of supporting specimens, tentatively excludes *melanocarpa* from the Manitoba flora. On the other hand Russell, Ledingham and Coupland (1954, *An Annotated List of the Plants of Saskatchewan,* University of Saskatchewan) exclude the red-fruited species from Saskatchewan flora.

Apart from the colour of the mature fruit various differences between the two forms have been described. *Melanocarpa* is said to be less astringent than *virginiana* and to have a denser raceme and a thicker leaf. Carmichael (1961, *Prairie Wildflowers,* J. M. Dent & Sons) states that the red-fruited species is found in southern Manitoba and southeastern Saskatchewan. "Its blossoms are white," (*melanocarpa* "rich cream") "a little larger and more loosely arranged on the raceme than those of the more common species. Its stems are gray, and quite different in appearance from the reddish brown stems of the other species". He says *melanocarpa* grows to 25 feet or over in height, while the red-fruited species seldom exceed 6 or 8 feet. Cunningham (1961, *Native Trees of Canada,* Canada Department of Forestry) states that the red-fruited choke cherry, *Prunus virginiana,* is red to dark red while var. *melanocarpa* is nearly black or rarely yellow. He does not list bark appearance as diagnostic. Some authorities, including Cunningham (as above), do not regard *melanocarpa* as a valid species but as a variety of *virginiana.*

The choke cherry of the portion of Manitoba between the Riding and Duck Mountains is *melanocarpa.* In the summer of 1963 I collected numerous specimens from this area and submitted them to the National Museum of Canada and to the Experimental Station at Swift Current for confirmation. Except in the rare, yellow-fruited phase the fruit here is dark purple, almost black, when fully mature. The raceme is dense, more so in old bushes than in younger plants and more so in open sun than in shade. The fruit is only mildly astringent when weather conditions permit full maturity. The stem is chocolate brown in new wood but with age becomes covered with a grayish overlay, apparently of dead cells, and often with lenticel-like scars. The flower colour ranges from almost white to cream. The plant height ranges to about 25 feet and the diameter of mature plants stems averages about 2 inches where suckering has full play. The area covered in my observations runs from about 1000 to 2700 feet above sea level. In the autumn of 1964 Thos. Adams advised me that there were several clumps of yellow-fruited choke cherry near Gilbert Plains village. He directed me to one of these and I secured specimens and colour photos of mature fruit and sent them to the National

Museum of Canada. As the choke cherries were severely damaged by spring frosts in 1964 it was not possible to determine any reliable correlations between fruit colour and other morphological features. The fruit was similar to the black in astringency but lacking in flavour.

(2) *White showy locoweed*

The showy locoweed, *Oxytropis splendens,* has normally a bluish, violet or purple corolla. It is a common plant on the stony moraine hills and eskers of the Duck Mountain. In the summer of 1963 I found a white-flowered specimen in the Forest Reserve, just east of Elk Lake. It was a well-grown specimen and did not differ from normal except in flower colour, which was creamy white except for a purplish suffusion on the outside of the corolla tube. The specimen along with a colour photo was sent to the National Museum. Dr. Scoggan (personal communication) advises me that this colour phase does not appear to have been previously reported, although similar variations have been noted in other members of the genus.

(3) *Range extensions for ground-plum, purple prairie-clover and golden pea*

Other normally prairie dwellers collected and photographed in the wooded Duck Mountain area in 1960-64 included:

Ground-plum, *Astragalus caryocarpus,* on the north shore of Cache Lake. First noted by Wm. Levins.

Purple prairie-clover, *Petalostemon purpureus,* west of Garland, on a morainic hill where the Singush highway crosses South Pine River.

Golden pea, *Thermopsis rhombifolia,* found along railway track about two miles west of Gilbert Plains by Warren Parker. This is normally a species of the southern prairies, although a clump was found at Churchill, thence probably by human vector, by Beckett (1959, *Adventive Plants at Churchill, Manitoba,* Canadian Field-Naturalist 73: 169-173).

Specimens of the ground-plum were sent to the Manitoba Museum and the prairie-clover and golden pea specimens to the National Museum of Canada.

JAMES L. PARKER

Box 99, Gilbert Plains
Manitoba
5 October 1964

CORRECTION NOTE

In the article "Additional records and a correction of the type locality for the Boreal Chorus Frog in Northwestern Ontario" Canadian Field-Naturalist 78(3): 186-192, the auditory records of Dr. A. E. Allin on the bottom of p. 187 for Fort William and Rossport should be corrected to:

Fort William, April 18, 1938; April 28, 1939; April 11, 1941; April 23, 1946; May 2, 1946, and Rossport, May 25, 1946.

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SOME NEW OR CRITICAL VASCULAR PLANTS OF ALASKA AND YUKON

A. E. PORSILD
National Museum of Canada, Ottawa, Ontario

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1. *Dryas Drummondii* Richards. var. *eglandulosa*, n. var.
2. *Calamagrostis kolymaensis* Kom., new to North America.
3. *Poa Jordalii, n. sp.*
4. *Saxifraga? eriophora* S. Wats, new to Alaska.
5. The Northern American races of *Primula tschuktschorum* Kjellm. of the Sect. NIVALES

1. ***Dryas Drummondii*** Richards. var. ***eglandulosa*** n. var.

D. tomentosa sensu Rydberg in N. Am. Fl. *22*:400-1 (1913); Bull. Torr. Bot. Cl. *41*:483 (1914); Flora of Rocky Mts. p. 430 (1918, 1922 and 1954). Henry, Fl. Southern British Columbia, p. 181 (1915). Hultén, Fl. Alaska and Yukon, p. 1044 (1946), not *D. tomentosa* Farr in Ottawa Naturalist *20*:110 (1906).

D. Drummondii f. *tomentosa sensu* Hultén, Sv. Bot. Tidsk. *53*, 4:525 (1959), not *D. tomentosa* Farr.

A varietas tomentosa (Farr) Williams *hypanthium cum calyce sine pilis glanduliferis, folia supra sat viridia glabra vel sparse arachnoidea differt.*

In habit the var. *eglandulosa* completely resembles *D. Drummondii*, except that its hypanthium and calyx are densely covered by gray, silky appressed pubescence and completely lack the black or purplish long, stipitate glands so characteristic for *D. Drummondii*, and present also on the hypanthium and calyx of all other species and "races" of *Dryas* known to me. It appears to be rare and local and thus far is known only from three collections from two widely disjunct areas:

Rocky Mountains: Banff National Park, Alberta, six miles below Pipestone Summit, elev. 6500 ft. July 7, 1904, John Macoun, No. 65125 (type of var. *eglandulosa*); Yoho National Park, British Columbia, scree slope north of Takkakaw Falls, elev. 5500 ft. July 1-4, 1951, A. E. Porsild, No. 15342. Alaska: Anchorage Cove, Glacier Bay, on raw glacial till, elev. 200 ft. Aug. 10, 1955, associated with typical *D. Drummondii*, D. B. Lawrence and R. E. Schoenike, Nos. 59 and 61.

The four collections cited include specimens in late anthesis and some with young fruits. In my No. 15342, last year's fruiting heads, containing well-formed and apparently normal achenes, were collected.

Mailing date of this issue: October 20, 1965

In my revision of the genus *Dryas* in North America (Porsild, 1947) I noted that Rydberg (l.c.) distinguished *D. tomentosa* by "hypanthium and calyx densely white hairy, not glandular," as opposed to "hypanthium and calyx densely hairy with black glandular hairs, only slightly tomentose" in *D. Drummondii*, whereas Farr (l.c.) correctly described her species as having "sepals densely glandular with purplish black stalked glands", but in other respects it was "Similar to *D. Drummondii*, but the leaves covered on both surfaces with a thick dense tomentum, giving them a pale gray colour above and white beneath".

Although I had not seen the type, I was very familiar then with the plant described by Farr, having collected it a number of times in the Canadian Rockies and in the Mackenzie District, concluding that it was analogous with the hirsute variations known to occur in other members of the genus: *D. intermedia* var. *canescens* Simm., *D. octopetala* var. *vestita* Beck, var. *argentea* Blytt and var. *hirsuta* Hartz. I observed further, that the var. *tomentosa*, although apparently rare, was generally associated with typical *D. Drummondii* and that its ecology was similar.

As to Rydberg's distinctly different concept of Farr's plant I could only assume that neither he, nor those who had accepted his version of the plant (Henry l.c., Hultén, l.c.), had seen the type of *D. tomentosa* Farr or authentic material of it and, perhaps, had not even read the original description of it.

In 1951, in Yoho National Park, B.C., I discovered a small colony of plants similar to *D. Drummondii*, except that the hypanthium and calyx entirely lacked the dark, stalked glandular hairs of that species (Porsild, No. 15342) and, recently, I received two additional samples completely matching mine, from Glacier Bay in Alaska, collected by Drs. D. B. Lawrence and R. E. Schoenike of the University of Minnesota. In his letter of transmittal Dr. Lawrence referred the specimens to *D. Drummondii* var. *tomentosa*, observing that they matched the description of *D. tomentosa* in N. American Flora. More recently still Dr. Schoenike, following an examination of the type of *D. tomentosa* Farr, commented in a letter on the discrepancy between Rydberg's description and that of Farr, to which I have referred above. He also called my attention to Rydberg's comments (1914) on the Macoun collection from Pipestone Pass. An examination of the latter (Macoun, CAN No. 65125) revealed that this completely matches the Yoho Park and Glacier Bay plants and, furthermore, provides the explanation to Rydberg's misinterpretation of what constitutes *D. tomentosa* Farr. Rydberg, clearly, had seen no authentic *D. tomentosa* Farr, and erroneously assumed that Macoun's No. 65125 was identical with it.

In his appraisal of the various taxa described in *Dryas*, Hultén (1946 and 1959) concluded that the various "races" cross freely when they meet, "so that a multitude of intermediate types occur". As far as I know the only authenticated hybrid in *Dryas* is *D. Drummondii* x *D. octopetala* (*D. Sündermannii* Kell.) which I have seen in a number of European botanical gardens. To me it resembles *D. octopetala* much more than *D. Drummondii*. Specimens now before me, from the alpine botanical gardens of Lindau, S. Germany, and Vienna, Austria have fully expanded, saucer-shaped flowers with white petals and completely glabrous filaments; and the outline and pubescence of the leaves,

and even the branched hairs on the midribs, are as in *D. octopetala*; the only visible character inherited from *D. Drummondii* is the vestigial bracts on the flowering peduncles, always lacking in *D. octopetala*.

There does not seem any evidence that either the var. *tomentosa* or var. *eglandulosa* are hybrids, or that their individual characteristics are not genetically fixed. At Great Bear Lake, N.W.T., where the var. *tomentosa* has been collected from a large number of stations, the only other potential parent is *D. integrifolia*. In the Rocky Mountain region *D. Drummondii* is a pioneer species on calcareous gravels of floodplains and is not found in the alpine zone. *D. Hookeriana*, also common in the region, and the much rarer *D. integrifolia*, are confined entirely to the alpine zone where they are found mainly on herbmat slopes abundantly covered by snow in winter, on strongly leached soils or on soils derived from non-calcareous rocks.

2. ***Calamagrostis kolymaenis*** Kom. in Not. syst. Herb. Horti Bot. Petrop. 2:129 (1921)
C. deschampsioides sensu Porsild, Trans. Roy. Soc. Can. 3rd. Ser. Sect. 5, vol. *32*:27 (1938); Rhodora *41*:179 (1939), *pro max. pte.*, not Trin.

Alaska: Little Diomede Island, A. E. and R. T. Porsild, Nos. 1651-2 (distributed as *C. deschampsioides*); Kukpuk R. east of Cape Thompson, abt. 68° 18′ N. and 165° 30′W., Herbert R. Melchior No. 690; Barrow, 71° 20′N. and 156° 40′ W., Kjeld Holmen, 61-1831; same place, I. L. Wiggins, No. 12961; Sunyorak Lake 14 mi. south of Barrow Base, I. L. Wiggins, No. 12618; (the last 3 distributed as *C. neglecta* or *C. neglecta* var. *borealis*).

Our specimens are a perfect match for a specimen distributed by the Herb. USSR, Leningrad from the mouth of Anabar R., 12 Aug. 1932, leg, V. Sochava.

The following description based on the above material is in close agreement with that given by Rozhevits in FL. USSR, 2:219 (1934).

Loosely tufted with numerous sterile ascending or curved leafy stolons; culms ascending-erect, often somewhat geniculate, 15 – 20 cm. tall, smooth, bearing 1 – 3 short, flat leaves; basal leaves flat, 1 – 3 mm. wide, much shorter than the culms, their ligules 0.5 – 0.7 mm. long, truncate or rounded. Panicle 2 – 4 cm. long and 0.5 – 2.0 cm. wide, dark purplish tinged, with short ascending and scabrous branches each bearing clusters of rather small spikelets. Glumes about equal, 3 – 4 mm. long, lanceolate, thin and papery, dark purple with golden-bronze tips, faintly scabrous on the keel; lemma about as long as the glumes, its awn as long as the lemma rising from or slightly below the middle, distinctly bent, and exserted at maturity; callus hairs unequal about half as long as lemma; anthers 1 – 1.2 mm. long.

C. kolymaensis differs from *C. neglecta* and its var. *borealis*, with which Alaskan specimens have been identified, by its purplish-bronze variegated, broader and more open panicle, by its thin and papery glumes and distinctly bent and exserted awn, and from *C. deschampsioides* by its more compact panicle with more numerous and smaller spikelets on shorter and scabrous branches.

C. kolymaensis is an arctic tundra plant thus far thought to be endemic to the arctic coast of eastern Siberia, between long. 113° and 160° E. Its presence in the flora of St. Lawrence Island was suspected by Hultén (1942, p. 172) but has not been confirmed.

3. ***Poa Jordalii*** n. sp. Fig. 1

Gramen perenne caespitosum, rhizomate brevi colonias parvis formante; culmi 8 – 12 cm. alti, filiformi stricti glabri et striati, folia duplo superantes, superne aphylli. Folia glabra viridia, anguste-duplicata; vaginae chartaceae, ligula truncata perbreviora. Panicula paucispiculata, augusta, ca. 2 cm. longa et 0.6 – 0.8 cm. lata, ramis brevibus glabris erectis 1 – 2-spiculati; spiculae variegato-coloratae ca. 5 mm. longae, 3 – 4-florae, compressae; glumae sub-aequales, lanceolatae, acutae, glabrae, ca. 4 mm. longae, inferior carinata, superior 3-nervia; palea inferior explanata, ovata sub apice aurea-hyalino-marginata 3-venia ad venam mediam et marginales crispato-ciliata, interstites glabris, basi sine lanugine. Antherae 0.5 – 0.75 mm. longae.

Poa Jordalii is named for the late Louis H. Jordal who, in the summers of 1949 and 1950, made extensive collections of plants from the south slope of the Brooks Range, Alaska. Among the several rare or critical plants which he presented to the National Herbarium of Canada was a dwarf *Poa* which he had referred to *P. abbreviata* R. Br. In recent years new and plentiful material of Jordal's little *Poa* has been collected also from the north slope of Brooks Range. With the ample material now available it becomes clear that our plant is abundantly distinct, not only from the high arctic, Amphi-Atlantic *P. abbreviata*[1], in which the lemmas are always densely short-pubescent, but also from the Cordilleran *P. Lettermani* Vasey which is known to me from high peaks of Banff National Park, Alberta and from mountains of northern British Columbia. By its short and dense panicle *P. Jordalii* differs most strikingly from *P. brachyanthera* Hult. of northern Alaska in which the panicle is pyramidal with the spikelets at the end of long, filiform branches, and it does not match *P. pseudoabbreviata Roshev.* or any other short-anthered Asiatic species known to me.

Poa Jordalii appears to be endemic to alpine limestone and quartzite ridges of the Brooks Range of northern Alaska: Brooks Range, south slope, Bettle's River, 20 miles northeast of Wiseman, in alpine tundra on limestone peaks, elev. 2000 ft. July 13, 1949, Louis H. Jordal No. 2284 (Type CAN); Brooks Range, north slope, 69° 23′ N. – 143° 39′ W., limestone ridge, elev. 3900 ft., July 13, 1957, Cantlon and Gillis, No. 57-836; same general area, east of Okpilak Lake, elevation 5500 ft., Cantlon and Malcolm, No. 58-0103 (CAN).

4. ***Saxifraga ? eriophora*** S. Wats, new to Alaska.

Two collections of a curious small Alaskan saxifrage of the Sect. MICRANTHES were sent to me by Dr. Leslie Viereck of the Northern Forest Experimental Station, College, Alaska. Both came from Eagle Creek, Eagle Summit, near mile 105 on the Steese Highway, lat. 65° 22′, long. 145° 20′; they

[1]In my map (Porsild, 1957, No. 36) showing the N. American distribution of *P. abbreviata*, two dots are erroneously shown for the Arctic Slope of Alaska and one in the Canadian Rocky Mts.

FIGURE 1. *Poa Jordalii, n.sp.* Alaska, south slope of Brooks Range, Bettle's River, in alpine tundra on limestone, elev. 2000 ft. Louis H. Jordal, No. 2284 (TYPE in CAN). x $\frac{1}{1}$.

grew on north-facing rock stripes and talus slopes at an elevation of 3500 – 4000 ft., and were collected on July 30 and Aug. 7, 1963 by Robert W. Weeden.

The collections include some specimens in late anthesis and some with well-formed fruits. The ovate blade of the rosette leaves is about 1.0 cm. long and

prominently serrate, glabrous and bright green on the upper surface; the underside of the blade and also that of the equally long petiole is dark purple under a dense cover of crinkly rust-coloured hairs. The inflorescence is 4 – 6 cm. long, characteristically paniculate, with ascending rather than spreading branches, not at all flat-topped and corymbiform as in *S. rufidula*. The 8 to 12 cm. tall scapes and the branches of the inflorescence are sparsely non-glandular hirsute throughout. The turbinate hypanthium and the non-reflexed sepals likewise are sparsely hirsute; the petals are linear or narrowly oblong or spatulate, about 2 mm. long, purple, longer than the stamens of which the filiform filaments are slightly longer than the anthers. The plump follicles are dark purple, about 5 mm. long, their tips slightly spreading.

By its characteristically paniculate inflorescence alone the Alaskan plant differs strikingly from *S. rufidula*, described from Vancouver Island, B.C. and known also from the states of Washington and Oregon (as *S. occidentalis* var. *rufidula* (Small) Hitchc. in Vascular Pl. of the Pacific Northwest). In the type of *S. rufidula* as well as in 7 other collections from Vancouver Island in the National Herbarium of Canada the scape and the branches of the inflorescence are glabrous, the petals white, 4 – 5 mm. long, orbicular or oval in outline, and more than twice as long as in the Alaskan plant which in every respect matches the description of *S. eriophora* S. Wats. Proc. Am. Acad xvii: 372 (1882) from Santa Catalina Mountains, Arizona and by Small (l.c.) and Engler & Irmsch. (l.c.) reported from nowhere else.

According to Engler & Irmsch. (l.c.) *S. rufidula* was collected in S.E. Alaska, Lynn Canal by A. & A. Krause. Hultén (Fl. Al. & Yukon, p. 937) tentatively accepts the report which has not been confirmed by more recent collections; no other reports or collections of *S. rufidula* are known to me from Alaska, Yukon or from the Canadian Rocky Mts.

5. The North American races of ***Primula tschuktschorum*** Kjellm. of the Sect. NIVALES.

In their monograph of *Primula* Smith and Fletcher (1942) reviewed the widely differing conclusions reached by authors who have dealt with the taxonomy and nomenclature of the eastern Asiatic and northwest American members of the Sect. NIVALES. In general they agree with Fernald (1928) that *P. tschuktschorum* Kjellm., as the earliest specific name, must be taken up for the plant inhabiting both shores of the northern Bering Sea area, but not that the var. *pumila* (Ledeb.) can be maintained even on varietal level. They agree also that *P. eximia* Greene and *P. Macounii* Greene are not specifically distinct and should be considered one somewhat variable but well marked variety of *P. tschuktschorum* for which Fernald's choice of term: *var. arctica* (Koidzumi) probably was unfortunate, because "it is not clear that the var. *arctica* Busch is equivalent to *P. arctica* Koidzumi" and that "the use of the term var. *eximia* would have been much less ambiguous".

Unaware of Smith and Fletcher's treatment Hultén (1948) under *P. tschuktschorum* Kjellm. noted the very wide variations within the large material cited by him, "so wide in fact that it seems unnatural to refer all to one species. The variation is, however, so irregular that it seems impossible to find any sharp

line of demarcation within this polymorphic type", and, concluded later, that "The confused condition . . . might have been caused by an ancient hybridization between *P. nivalis* and one or two other closely related species in the Bering Region". Under *P. tschuktschorum* he, accordingly, cited as synonyms all names or combinations applied previously to Alaskan plants of the Sect. NIVALES but, somewhat illogically, nevertheless reported *P. nivalis* Pall. s. str., known to him then only from a single collection from Cape Prince of Wales (Anderson No. 4979).

The most recent treatment of the Amphi-Beringian members of the Sect. NIVALES is that of A. Fedorov in Fl. U.S.S.R., Vol. 18 (1952) who recognizes *P. tschuktschorum* Kjellm., *P. arctica* Koidzumi and *P. eximia* Greene. From the nomenclature and illustrations cited, as well as from a perusal of his key, it seems clear that *P. arctica sensu* Fedorov is not specifically distinct from *P. tschuktschorum* Kjellm.

The lack of "solid" morphological characters by which to separate elements of the Sect. NIVALES in the Bering Sea region is apparent to anyone who has examined representative samples, or the key characters employed by authors to separate the different taxa in the section. Thus in Smith and Fletcher's key (l.c. p. 570) *P. nivales* and *P. tschuktschorum* are separated as follows:

H. Leaves ± regularly serrate or serrulate:
  I. Leaves oblong or ovate or elliptic; imbricated stock present (N. and C. Asia) *P. nivalis*
HH. Leaves entire or very obscurely crenulate:
  II. Dwarf species without an imbricated stock (Arctic) *P. tschuktschorum*

In Hultén's key (l.c. p. 1267) we find:

A. Limbs of corolla entire [as opposed to limbs emarginate or obcordate]
  B. Leaves large (about 10 cm.), farinose below, obtuse, regularly denticulated, leafless sheaths at the base of the rosulae lacking *P. nivalis*

  B. Leaves smaller, usually efarinose, acute or acutish, not so regularly denticulated, leafless, usually farinose sheaths at the base of the rosulae *P. tschuktschorum*

In the National Herbarium of Canada are two dozen collections of Alaskan *P. tschuktschorum* var. *arctica* (*sensu* Fernald); about one third of the individual plants have imbricated, leafless sheaths at the base of the stock, the rest not. In approximately one third, some with and some without imbricated stock, the leaves are essentially entire-margined while among the rest all or at least some of the leaves are regularly denticulate or serrate. Far from being "dwarf" plants their leaves vary from 7 – 18 cm. in length by 1 to 2 cm. in width, and some have fruiting scapes up to 40 cm. high. About one half of the plants are efarinose while in the remainder at least some parts are farinose. In a few plants the corolla lobes are distinctly emarginate.

An examination of an equally large series of *P. tschuktschorum* ssp. *tschuktschorum* shows that all have entire leaves, and about one third have leafless sheaths at the base of the stock; a few are moderately farinose, and mainly

on the floral pedicels and bracts, and a fair number have emarginate or even notched corolla lobes.

To the representative series of *Primula* Sect. Nivales from the Bering Sea region in the National Herbarium have recently been added important new material from both shores of Bering Strait, from Saint Lawrence Island and from interior Alaska and Yukon, besides a fine series of large colour transparencies of *P. tschuktschorum* from Cape Thompson, Alaska.[1]

Pending clarification by experimental methods of this small but troublesome group, a review is attempted here in order to deal with the new material.

Key to the races of *Primula tschuktschorum* Kjellm.

A. Dwarf plants with scapes not greatly elongated in the postfloral state; leaves linear to linear-lanceolate, entire, much shorter than the scapes; umbels 2 – 3 or rarely up to 5-flowered. Entire plant commonly glabrous, or if farinose, this is sparse and restricted to the summit of scape, bracts, peduncles and calyces. Plants inhabiting arctic sea-shores and wet meadows and cliffs by the sea

B. Corolla lobes oblong, obtuse ssp. *tschuktschorum*

B. Corolla lobes linear-cuneate, distinctly notched or more rarely cleft to the base ssp. *tschuktschorum* var. *beringensis*

A. Tall and coarse plants 20 to 40 cm. tall with scapes much elongated in fruit; lvs. glabrous, 6 – 16 cm. long and 1 – 2.5 cm. broad, spatulate, oblong or oblanceolate with entire, crenate or serrate margins, winged petiole and clasping base

C. Umbels 5 – 10 (16)-flowered; scapes 3 – 6 mm. in diam., in fruit up to 40 cm. tall; lvs. 10 – 18 cm. long and 1.0 – 2.0 cm. wide, dark green shiny and somewhat fleshy in life, entire or crenate along the margins. Plant sometimes totally glabrous but more commonly the upper part of the scape, bracts, pedicels and calyx distinctly white-farinose; calyx cleft halfway to the base. Seeds angular with vesicular testa, commonly 1 x 0.6 mm. Moist grassy tundra. *ssp. eximia*

C. Umbels 3 – 5-flowered, scape slender, 2 – 4 mm. in diameter and 13 – 20 cm. high, not much elongated in fruit; lvs. thin, fresh green, opaque, narrowly lanceolate, 5 – 7 cm. long and 6 – 10 mm. wide, with flat or revolute distinctly serrate-crenate margins, the blade tapering into a slender petiole. Underside of lvs., bracts and peduncles farinose in youth, glabrate in age. Calyx blackish purple, cleft nearly to the base, lobes narrowly acute. Seeds largest in the group, vesicular, averaging 1.8 x 0.7 mm. Plants of moist alpine tundra of interior Alaska and Yukon. ssp. *Cairnesiana*

Primula tschuktschorum* spp. *tschuktschorum

P. tschuktschorum Kjellm. in Nordenskj. Vega-Exp. Vetensk Iagtt. I:516, tab. ix (1882).

The synonymy given by Smith and Fletcher together with their clear and detailed description clearly delimits the ssp. *tschuktschorum*. It is very doubt-

[1]Part of a set of 750 mounted 2¼″ x 2¼″ slides illustrating 354 species of arctic phanerogams and ferns presented to the National Herbarium of Canada by the late Dr. Raymond Wood of Salt Lake City, Utah, who made the photographs during seven botanical forays to West Greenland, arctic Canada and Alaska.

ful, however, if Kamtchatka should be included in its range because Hultén (1928, p. 50) clearly stated that the Kamtchatka plant agrees completely with *P. eximia* Greene and "differs so markedly from the type of *P. tschuktschorum* Kjellm. in Herb. Holm. that it seems quite impossible to unite the two plants". The Kamtchatka specimens of Rieder 1831 and Lewitzky 1848, cited by Hultén under *P. nivalis* Pall. var. *subintegerrima* Regel, according to him differ from *P. eximia* chiefly by being more highgrown, and thus do not match the arctic ssp. *tschuktschorum.*

Smith and Fletcher obviously were uncertain about the identity of *P. arctica* Koidzumi in Bot. Magazine [Tokyo] xxv:216 (1911). Koidzumi (l.c.) cited no type nor is it clear if he had seen actual specimens. However, his statements: "*glabra, circ. 5 cm. alta*" and "*umbellam 3 floram gerens — Hab. Tschuktschor.: Port providence*", make it abundantly clear that ssp. *tschuktschorum* was meant. It is difficult therefore, to understand why Fernald (l.c.) followed E. Busch in equating the dwarf *P. arctica* Koidz. with the tall and coarse *P. eximia* Greene and *P. Macounii* Greene, the more so because he had seen and annotated the type sheets of both, besides much additional material from the Pribilof Islands and elsewhere, in the National Herbarium of Canada.

The ssp. *tschuktschorum* is a littoral plant (Kjellman, 1882, and Kurtz, 1894). On Little Diomede Island it grew in moist ravines reached by spray from the sea (Porsild, 1939). Its seeds, like those of ssp. *eximia*, are small and angular, 1.0 x 0.6 mm. with a vesicular testa.

spp. ***tschuktschorum*** var. ***beringensis*** n. var. Fig. 2, a-d.

Folia angusta; corollae lobi anguste-cuneati, emarginati vel profunde laciniati.

Plant efarinose with almost linear leaves 2 – 3 cm. long and 2 mm. wide; the scapes are 7 – 8 cm. tall, 1 – 3-flowered; corollas about 2 cm. in diameter, with linear or narrowly cuneate lobes prominently notched or, sometimes cleft to the very base. Fruiting state not known.

Alaska: Saint Lawrence Island, Boxer Bay, in wet areas on tundra terrace, flowering on June 18 – 24, 1960, leg. E. G. Franz Sauer (type CAN Nos. 283882-3). Known only from the type locality.

ssp. ***eximia*** (Greene) n. stat.

P. eximia Greene in Pittonia 3:251 (1897); J. M. Macoun in The Fur Seals and Fur Seal Islands of the N. Pacific Ocean, Pt. *3*:568 and tab. 42 (1899); Pax and Knuth in Engler's Pflanzenr. iv. 237, H. *22*:106 (1905), in part; Hultén, Fl. Kamtchatka iv:50 (1930); *idem*, Fl. of the Aleutian Islands p. 272 (1937).
P. Macounii Greene, Pittonia *3*:251 (1897); J. M. Macoun, l.c. p. 569, tab. 43.
P. tschuktschorum var. *arctica sensu* Fernald in Rhodora *30*:63 (1928), not *P. arctica* Koidzumi in Bot. Mag. (Tokyo) *25*:216 (1911), nor *P. pumila* var. *arctica* E. Busch in Fl. Sib. et Orient. Extr. iv:75, tab. A (1925). Smith and Fletcher in Trans. Roy. Soc. Edinb. *60*, 2:609 (1942) *pro max. pte.*
P. tschuktschorum sensu Hult. in Fl. Alaska & Yukon, p. 1275 (1948) *pro pte.*
P. nivalis sensu Kjellm. Vega Exp. Vet. Iagtt. I, p. 515 (1882); Hultén, Fl. Alaska and Yukon, p. 1272 (1948); ibid. p. 1769 (1950), not Pall.

FIGURE 2. *Primula tschuktschorum* var. *beringensis*, n. var. a-c. Flowering plants from St. Lawrence Island, Bering Sea, Boxer Bay, x $\frac{2}{3}$. d. flowering umbel in which corolla lobes are cleft to the very base, x $\frac{4}{3}$. Franz Sauer, June 12-24, 1960. (Type in CAN and WIS).

Greene (l.c.) designated no types for *P. eximia* and *P. Macounii.* The Pribilof specimens from which Th. Holm's drawings were made (J. M. Macoun, l.c. pl. 42 and 43) are in the National Herbarium of Canada and must be considered the holotypes. They are *P. eximia*, Macoun Nos. 93497 and 93505; *P. Macounii*, Macoun Nos. 93469 and 93501.

The luxurious growth of ssp. *eximia* in the Pribilof Islands, probably not matched elsewhere, with individual plants attaining a height of 40 cm. and with up to 16-flowered umbels, may be due to the richness of the soil on these islands well known as the breeding grounds of great herds of fur-seals, and the nesting sites of countless seabirds. However, in his description of the vegetation of the islands, J. M. Macoun (1899) does not mention the fertilizing effect of seals and birds if, indeed, such was apparent. According to Smith and Fletcher (l.c.) plants grown in Edinburgh from seeds of *P. eximia* obtained in the Pribilof Islands "were in accord with . . . . herbarium material from the same source".

J. M. Macoun, l.c. p. 569 noted that "in living plants the flowers are much lighter in colour in *P. eximia* than in *P. Macounii*, varying much, however, in dried specimens". In view of this observation it is strange that he failed to mention a specimen collected by him on St. Paul Island on July 29, 1897 in

FIGURE 3. *Primula tschuktschorum* ssp. *Cairnesiana,* n. ssp. a. flowering plant, b. fruiting umbel from Richardson Mts., Yukon-Mackenzie border, J. A. Calder, No. 34099 (DAO). c. Central Alaska, White Mts., head of Sourdough Creek, Olav Gjaerevoll, No. 1055 (Type, CAN and TRH)., x 3/5.

which the corolla is pure white. On the herbarium sheet in Ottawa he even marked the specimen "albino".

Primula tschuktschorum ssp. ***Cairnesiana*** n. ssp. Fig. 3, a-c.

Planta robusta, elata. Folia angusto-lanceolata, 5 – 7 cm. longa, 0.6 – 1.0 cm. lata, firma, viridia, denticulata vel crenulato-denticulata, sub anthesi ad

paginas inferiores ± farinosis, in petiolum laminam subaequantem sensim attenuatis. Scapus 13 – 20 cm. longus in post-anthesim paulo elongatus, 2 – 4 mm. latus; unbellam 3 – 5-floram gerens; pedicelli sub anthesi 3 – 8 mm. longi, post-anthesim 2.0 – 3.5 cm. longi; flores ± cernui; calycis farinosi vel efarinosi ultra medium fissi, lobi lineari atro-purpureis; corollae purpureae, lobi obovati retusi. Capsula calycem saepius duplo superans. Semina magna, angulata, vesiculata, 1.3 – 1.8 mm. longa, 0.6 – 7 mm. lata.

The spp. *Cairnesiana* differs from ssp. *tschuktschorum* by its more robust habit, by its non-shiny, pale green and distinctly denticulate leaves and by its more deeply divided calyx. From ssp. *eximia* it differs by its narrower, lanceolate rather than oblanceolate-spatulate leaves the blade narrowing into a slender petiole, by its narrower and more deeply divided calyx lobes and few-flowered umbels, and by its seeds that are nearly twice as large as those of ssp. *eximia* and ssp. *tschuktschorum*. Ssp. *Cairnesiana* is named for Dr. C. E. Cairnes of the Geological Survey of Canada, the first to collect it, on the Ladue River, Y.T., lat. 63° 50′ N. 141° W., on July 5, 1917 (CAN 93324). The present description is based on newer and better developed specimens: Central Alaska, White Mountains, fruiting specimens on Aug. 9, 1953 from headwaters of Sourdough Creek, on a moist snowbed, elev. 990 m. Olav Gjaerevoll, No. 1055 (TYPE) CAN 225136; Richardson Mts. on Yukon – Mackenzie border, 67° 33′ N. and 136° 12′ W., in wet meadows at about 3200 ft. elev., flowering specimens on July 8 and 9, 1962, J. A. Calder, Nos. 34062 and 34099 (DAO).

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THE STATUS OF THE BLACK COTTONWOOD (*POPULUS TRICHOCARPA* TORREY AND GRAY)

T. C. Brayshaw

Forest Research Branch, Department of Forestry,
Forest Experiment Station, Chalk River, Ontario

Several years of study of native Canadian poplars has revealed that a problem that should no longer be ignored exists in the identification of two species of *Populus*, in the section *Tacamahaca*. These two closely related species are *P. balsamifera* L., the balsam poplar of wide occurence in the Boreal Forest, and its cordilleran relative, *P. trichocarpa* Torrey and Gray, the black cottonwood of the west.

The range maps published by Sudworth (1934) and in *Native Trees of Canada* (Anon., 1956) show *P. balsamifera* as occurring from the Rocky Mountains eastward, and *P. trichocarpa* as occurring only west of these mountains. Moss (1959) mentions the latter as occurring in southwestern Alberta. The above-mentioned range maps also indicate a large area of *P. balsamifera* on both sides of the Rocky Mountains in Montana and Idaho. However, White (1951) knew of no trees of this species in Montana that were clearly native, all the specimens being shown, when identifiable, to be *P. trichocarpa*, within which extreme variability had apparently led to confusion and misidentification. Further confusion is caused by the presence of *P. angustifolia* and *P. deltoides* var. *occidentalis*, both of which can cross with the species considered here, which have been found experimentally to be interfertile.

Many of the specimens in herbaria are vegetative only and so lack the intrinsic characters by which they can be assigned definitely to one species or the other. Such specimens appear to have been identified by their collectors mainly on the basis of locality of collection, assuming that the ranges are as clearly defined in nature as they appear to be on the maps.

Even when comparison is made of specimens drawn from areas where the species are remote from each other it has been found that vegetative characters alone are not satisfactory for distinction, and such a feature as the number of bud scales, mentioned in some manuals, is quite unreliable. Saplings can sometimes be distinguished by their stem sections:— vigorously growing shoots of *P. trichocarpa* often have angled stems while those of *P. balsamifera* are terete. Although there is a tendency for the leaves of *P. trichocarpa* to be slightly wider on the average than those of *P. balsamifera*, the ranges of their dimensions overlap almost completely so that such a character cannot be used to distinguish the species.

P. balsamifera in eastern Canada usually has glabrous petioles; but some specimens occur with pubescence on the petiole and on the veins on the dorsal surface of the leaf, which is also subcordate to cordate at the base. These variants have been recognized as var. *subcordata* Hylander. This variety be-

comes more common westward, until in Alberta it appears to be the common variety in the species. This same combination of pubescence and leaf shape characteristics is the common one in *P. trichocarpa.*

The only characters that can be used with reliability to separate the species are those of the flowers and fruit. They are expressed as follows:

P. balsamifera. Staminate flowers with 12 to 20 stamens. Pistillate flowers with bicarpellate ovaries, producing two-valved, lanceolate, glabrous capsules.

P. trichocarpa. Staminate flowers with 40 to 60 stamens. Pistillate flowers with tricarpellate ovaries, producing three-valved, globose or subglobose, pubescent capsules.

Staminate and pistillate flowers normally occur on separate trees. Flowering occurs in early spring in both species. The staminate catkins are promptly shed and soon disintegrate on the ground so that they are seldom found in a recognizable condition in the summer or autumn. The pistillate catkins persist longer on the tree, until their seeds are matured and released; but are usually shed in June and July. They may be identifiable under the tree during the remainder of the year.

During the summers of 1959 and 1963 numerous collections of *Populus* were made in Alberta and British Columbia for critical examination. Fertile material was obtained whenever possible, but in 1959 the incidence of flowering was disappointingly low and the complete analysis had to wait until further collections could be made in 1963, a better flowering season. Unfortunately field work did not start early enough to get the staminate catkins. Consequently pistillate material only had to be used for analysis. If all the trees had flowered it would have meant that about half would have been identifiable, but since only a portion flowered, even in 1963, the bulk of the population could not be assigned unquestioningly to either species.

An eight-point linear hybrid index, of the kind described by Anderson (1949) and based on the capsule characters outlined above, was appied to all material with pistillate catkins. The scoring of this hybrid for a total of 8 points is set out in Table I. The distribution of hybrid index values based on fertile pistillate specimens from Alberta and adjacent British Columbia is mapped in Figure I.

The result of the scoring showed that though '*balsamifera*' characteristics generally prevail in material from Saskatchewan eastward and '*trichocarpa*' characteristics in material from west of the Rocky Mountains, the correlation is not completely consistent and trees with characteristics of one species may occur sporadically in areas generally supposed to be occupied only by the other. Over a large area of Alberta and eastern and central British Columbia pistillate material showed characteristics of both *P. balsamifera* and *P. trichocarpa* in various proportions. In much of this region, most of the specimens, when they could be identified, proved to be intermediate.

The scattered collections in central British Columbia (westward beyond the map area) include several specimens with intermediate index values, and some specimens indistinguishable from typical *P. balsamifera* (hybrid index

TABLE 1. — Hybrid index values assigned to specimens of the *Populus balsamifera* — *trichocarpa* complex.

Character	*Expression*	*Points assigned*
Capsule shape:	lanceolate	0
	ovate	1
	globose or subglobose	2
Capsule pubescence:	none	0
	sparse	1
	abundant	2
Number of carpels:	always 2	0
	mostly 2, occasionally 3	1
	2 and 3 equally frequent	2
	mostly 3, occasionally 2	3
	always 3	4

Maximum index value (= *trichocarpa*) : 8 ;
Ideal *P. balsamifera* = 0

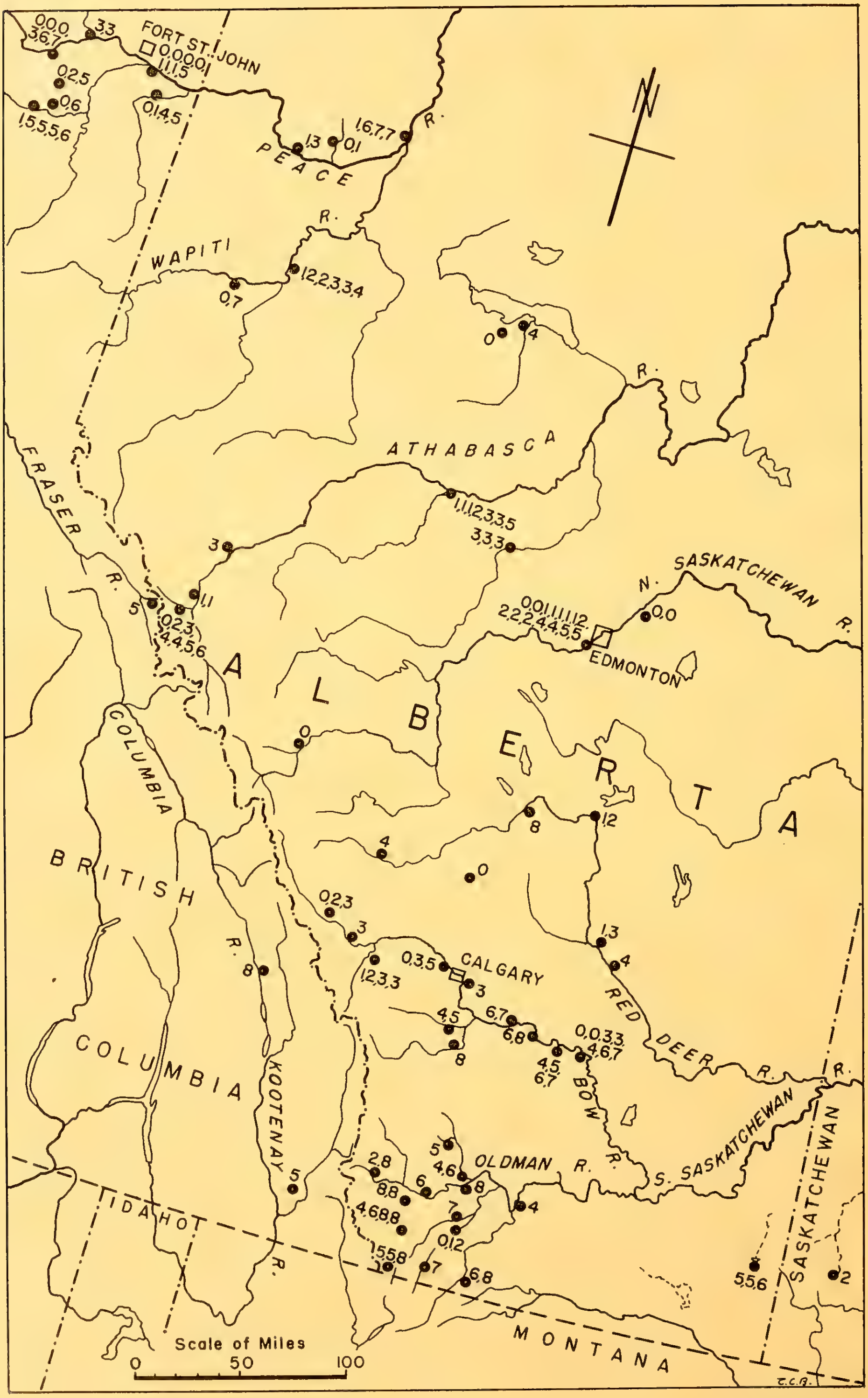
= 0) from as far west as Fort St. James, 150 miles into British Columbia. It can be seen that in this portion of western Canada it is not practicable to separate the species.

Apparently, during the major advances of the Pleistocene ice sheets the ancestral population of the complex became divided into an eastern and a western population, with the prairies between them. While isolated, these two races evolved the few morphological differences now used to distinguish them in their typical forms, but their isolation did not last long enough to permit them to evolve effective sterility barriers. Thus these two races, having subsequently made contact, have interbred freely to produce the widespread mixed population that is found today; and genes from each have been transported for long distances into the range of the other.

P. trichocarpa var. *hastata* (Dode) Henry, originally proposed as a species, *P. hastata*, by Dode (1905), is described as having larger, more acuminate leaves than the typical variety of the species, and glabrescent capsules. It falls within the range of individual variation in the species in its vegetative characters, and appears to be one of the variants that can be generated by introgression of *P. trichocarpa* by *P. balsamifera*. Individuals of this kind are found scattered through the population of *P. trichocarpa*, becoming increasingly common as the range of *P. balsamifera* is approached.

The most realistic treatment of these two taxa is to consider them as comprising a single species, with two subspecies. When combined in this way, the inclusive species must bear the name *P. balsamifera* L., which has priority according to Article 57 of the International Code of Botanical Nomenclature (Lanjouw 1956).

A name that has been applied to the black cottonwood as a variety of the balsam poplar is *P. balsamifera* var. (?) *californica* S. Watson (1879) (the query


FORT ST. JOHN
PEACE R.
WAPITI
ATHABASCA R.
FRASER R.
N. SASKATCHEWAN R.
EDMONTON
ALBERTA
COLUMBIA
BRITISH COLUMBIA
KOOTENAY R.
CALGARY
RED DEER R.
BOW R.
OLDMAN R.
S. SASKATCHEWAN
SASKATCHEWAN
IDAHO
MONTANA
Scale of Miles
0 50 100

is Watson's). The description, however, does not apply to his type material very well; nor does it agree with the normal form of *P. trichocarpa*, which he also recognized. Watson's description was based on foliage alone; he assumed the capsules would be glabrous and two-valved. The pubescent, three-valved capsuled catkins that are mounted on the same sheet with the type specimen apparently were added with another collection from the same locality (Yosemite Valley, California). The original collection seems to have been from a stunted juvenile specimen, judging by the short petioles. In effect, this name applies to some aberrant individual found within the range of *P. trichocarpa* and is a "nomen confusum".

The present writer considers that *P. trichocarpa* of Torrey and Gray when united with *P. balsamifera*, is worthy of an infraspecific rank higher than that of variety. Since no name for this taxon in the rank of subspecies is available, it is here proposed to assign that status to it.

Thus, in the Cordilleran and adjacent regions, the poplars of the Section *Tacamabaca* include the following taxa:

Populus balsamifera L., Sp. Pl. 1:1034. 1753, subsp. *balsamifera*, var. *balsamifera* L.

P. balsamifera L., subsp. *balsamifera*, var. *subcordata* Hylander, Fören. Dendrol. Parkv. Arsb. Lustgarden 111. 1945.

P. balsamifera L., subsp. ***trichocarpa*** (Torrey and Gray) stat. nov. (*P. trichocarpa* Torrey and Gray, ex Hooker, Icon. Pl. 9 (2nd Ser.): pl. 878. 1852).

P. balsamifera L., subsp. *trichocarpa* (Torrey and Gray) Brayshaw, var. ***hastata*** (Dode) stat. nov.
(*P. hastata* Dode, Soc. Hist. Nat. Autun, Bul. 18:222.1905).
(*P. trichocarpa* Torrey and Gray, var. *hastata* (Dode) Henry in Elwes and Henry, Trees of Great Britain and Ireland 7: 1837. 1913).

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FIGURE 1. Locations of sampled stands of *Populus balsamifera* in Alberta and adjacent British Columbia, with the hybrid index values of all fertile pistillate specimens found.

NEW PLANT RECORDS FROM NORTHWESTERN MACKENZIE DISTRICT, N.W.T.*

W. J. Cody
Plant Research Institute, Ottawa, Ontario

In 1953, I first visited the Mackenzie River Delta. At that time accompanied by Mr. Robert L. Gutteridge, I spent the period August 12-16 in the immediate vicinity of Aklavik. From June 7 to August 20, 1957 Mr. Don Ferguson and I carried out a survey of the vegetation in the eastern part of the Mackenzie Delta and a large part of the Reindeer Grazing Preserve. Again from June 29 to August 2, 1963 I revisited the Reindeer Grazing Preserve. During these surveys many plant specimens were gathered. The mosses collected in 1957 have already been reported upon by W. C. Steere (1958). Among the vascular plants were a number of particular interest. These are recorded below.

The area under study was roughly that covered by the Port Brabant map sheet (Canada Department of Mines and Resources, National Topographic Series Sheets 107 SW and 107 SE). It lies between 68° and 70° N latitude, and 128° and 136° W longitude. A map of the region is shown in Figure 1. The exact co-ordinates of some of the more important collecting localities are:

Aklavik	68°13′N	135°00′W
Campbell Lake	68°14′N	133°28′W
Inuvik	68°18′N	133°40′W
Kidluit Bay	69°31′N	133°48′W
Reindeer Station	68°42′N	134°08′W
Toker Point	69°38′N	132°54′W
Tuktoyaktuk (Port Brabant)	69°27′N	133°02′W
Warren Point	69°44′N	132°30′W

In the paragraphs which follow, the abbreviations MRD (Mackenzie River Delta), AC (Arctic Coast between East Branch Mackenzie River and Anderson River) and ELB (Eskimo Lake Basin) have been used to conserve space. Collection numbers are those of the author unless otherwise stated. The specimens are preserved in the Phanerogamic Herbarium of the Canada Department of Agriculture, Ottawa (DAO).

Equisetaceae

Equisetum fluviatile L. ELB: among *Carex aquatilis* rooted in ooze of small bay, Eskimo Lakes, south end of westernmost lake at mouth of Sitidgi Creek, 68°41′N, 132°55′W, *10795*.

Hooker (1829-40) recorded *E. fluviatile* "... to the shores of the Arctic Sea". In the Mackenzie River Delta this species forms extensive colonies on depositing silty river shores and strongly woven mats about the shores of small lakes in the delta islands at least as far north as the Reindeer Station on the East Branch. It has not previously been recorded from the Eskimo Lake Basin. This collection, although sterile and somewhat smaller than collections from the vicinity of the Reindeer Station, seems best referred here.

Lycopodiaceae

Lycopodium annotinum L.

Specimens collected at Aklavik (*7895*) and in the vicinity of the Reindeer Station (*9594*, *10109* and *10435*) have mostly spreading to

*Contribution No. 423 from the Plant Research Institute, Research Branch, Canada Department of Agriculture, Ottawa, Ontario.

FIGURE 1. Map of Reindeer Grazing Preserve (limits shown by heavy line) and Mackenzie River Delta.

reflexed leaves and hence are referred to var. *annotinum* even though the leaves are much shorter than or barely reach the lower limit of the 5.5 - 11.0 mm length ascribed to the variety by Fernald (1950). Specimens from the Eskimo Lake Basin (*10529, 10638* and *10815*) are referred to var. *pungens* (La Pylaie) Desv.

SELAGINELLACEAE

Selaginella sibirica (Milde) Hieron.

When Tryon (1955) wrote his monograph of the genus *Selaginella*, this species was known to him from Yukon and Alaska to Trans Baikal, Manchuria and Japan. Porsild (1943) had however already reported its presence on the steep west-facing Caribou

Hills on the east bank of the Mackenzie River, where I have also collected it, and at the south end of Richards Island. Porsild, in addition, stated that it had not previously been recorded from north of Lake Athabaska. Raup (1935) and Tryon (1955) however cited these Lake Athabaska specimens *as S. rupestris*, as are my specimens from Fort Fitzgerald, Alberta (Cody, 1956), the northwesterly known extent of that species.

PINACEAE

Larix laricina (Du Roi) K. Koch MRD: a few trees to 30 ft. in height and dbh 5 inches, near lakeshore, Campbell Lake, 10 miles southeast of Inuvik, *12738;* ELB: in front of cabin, Anderson River Forks, *W. E. Stevens* s.n., 25 Aug. 1948 (DAO).

The Stevens specimen was taken at the junction of the Carnwath and Anderson Rivers in the southeastern section of the Reindeer Grazing Preserve (68°25′N, 128° 48′W) and is the northernmost collection yet recorded for the species. According to Stevens, in conversation, the trees, which grew to a height of about 5 ft. were not common. Small trees are found occasionally in black spruce muskeg north to Inuvik in the area adjacent to the East Branch Mackenzie River. Also, between Hyndman Lake to the east, and the Anderson River, trees to 40 ft. in height were observed (from the air) in open stands of *Picea*. The northern limit of *Larix* is south of that of both *Picea glauca* and *P. mariana.*

POTAMOGETONACEAE

Potamogeton vaginatus Turcz. MRD: very common rooted in muck in 3 to 4 ft. water of small lake, Williams Island opposite Reindeer Station, *10887;* ELB: shallow water one to two ft. deep by lake shore, Crossley Lakes, 68°35′N, 129°30′W, *13116.*

Not previously recorded from north of Great Bear Lake some 300 miles to the southeast (Raup, 1947).

Potamogeton friesii Rupr. MRD: in 12 inches water, 68°42′N, 134°07′W [near Reindeer Station] *I. McT. Cowan, 38* (DAO); ELB: common in 2 ft. water in embayment cut off by sand spit at mouth of creek just north of Standley Creek, west side of westernmost lake, 68°48′N, 133° 24′W, *10692.*

This is a northwestward extension of the known range of some 300 miles from Norman Wells (Cody, 1960) and Great Bear Lake (Raup, 1947). Our specimens are all in sterile condition.

Potamogeton gramineus L. MRD: occasional patches rooted in muck in 3 to 4 ft. water of small lake, Williams Island, opposite Reindeer Station, *10888;* 30 miles S of Aklavik, *W. E. Stevens, s.n.*, 20 July 1948 (DAO).

This is a range extension of some 300 miles northwest from Norman Wells (Cody, 1960) and Great Bear Lake, (Raup, 1947).

Potamogeton richardsonii (A. Benn.) Rydb. MRD: occasional, rooted in muck in 3 to 4 ft. water of small lake, Williams Island, opposite Reindeer Station, *10886;* ELB: shallow water 1 to 2 ft. deep by lakeshore, Crossley Lakes, 68°35′N, 129°30′W, *13117A.*

These collections represent a northwestward extension of range of some 300 miles from Norman Wells (Cody, 1960) and Great Bear Lake (Raup, 1936).

GRAMINEAE

Poa lanata Scribn & Merr. MRD: Sandy hilltop, Old Army Camp, East Channel Mackenzie River, 69°17′N, 133°54′W, *10368.*

Our specimen, which has the sides of the lemma quite lanate-pubescent, keys out readily in Hultén's Flora of Alaska and Yukon. Porsild (1951) collected *P. lanata* at a number of stations along the Canol Road in the Yukon Territory, but it has not previously been recorded for Mackenzie District.

Agropyron trachycaulum (Link) Malte *ex* H. F. Lewis MRD: moist gravel in waste area, Inuvik, *13159.*

Presumably introduced in this situation; otherwise known only as far north as Norman Wells (Cody, 1960). The specimens cited by Porsild (1943) under *A. trachycaulum* must be referred to *A. sericeum* (see note under that species).

Agropyron sericeum Hitch., *A., trachycaulum sensu* Porsild (1943) MRD: open site, dry, top of high bank above river, Aklavik area, *W. E. Stevens, 5* (DAO);

forming clumps, rare in disturbed ground around buildings, Reindeer Station, *10144;* common in clumps in disturbed areas throughout the settlement, Reindeer Station, *10968, 13084;* occasional in wet silt on low bank of alluvial island opposite Reindeer Station, Williams Island, *10383, 10384;* silty lake bank, Campbell Lake, *12648;* ELB: river bank, Anderson River, 69°16'N, 128°15'W, *12620.*

Porsild (1943) states that the specimens he cites from Mackenzie River Delta and Great Bear Lake have pubescent lemmas. This would place them with *A. sericeum* rather than *A. trachycaulum.* (Hooker (1829-40) described this plant as *Triticum (Agropyrum) repens* L. δ *subvillosum,* the type coming from Fort Norman on the Mackenzie River. In Mackenzie District *A. sericeum* is known from along the Liard River (Cody, 1963), along the Mackenzie River from Fort Simpson to near the Arctic Coast, along the Anderson River and around Great Bear Lake (Cody, 1960, 1961; Porsild, 1943).

Agropyron alaskanum Scribn. & Merr. var. *alaskanum* MRD: shallow soil in crevice of limestone talus slope, rare, Campbell Lake, *12681, 12717;* ELB: scattered in moist sand of sand spit, Eskimo Lakes (west side of westernmost lake), *10728;* in humus in dog yards in cabin clearing, Crossley Lakes, 68°35'N, 129°30'W, *13108;* AC: rare in humus over sandy gravel by bay, Tuktoyaktuk, *10902;* in fertilized area around ground squirrel burrows, Cape Dalhousie, 70°13'N, 129°40'W, *13135.*

Our specimens all have more or less pubescent nodes and hence must be referred here. Nos. *12681* and *12717* however have the awn of the lemma longer than the body of the lemma which according to the key in Hultén (1941-52) would place them with *A. subsecundum,* which they are not. Previously recorded from Mackenzie District only from along the Liard River, Indin Lake and Port Radium on Great Bear Lake (Cody, 1963).

Elymus innovatus Beal ELB: steep eroding middle slope of 500 ft. hills, Anderson River, 69°16'N, 128°15'W, *12593.*

This is an eastward extension of range from the Caribou Hills on the East Branch of the Mackenzie River where it occurs in a similar situation.

Hordeum jubatum L. MRD: moist clay near river, Aklavik, *7916;* moist gravel in waste area, rare, Inuvik, *13163;* waste ground by buildings, Inuvik, *13158.*

This is a range extension of some 300 miles northwest from Norman Wells (Cody, 1960); it is likely introduced at these localities.

Calamagrostis inexpansa A. Gray AC: occasional in sod over sandy gravel by bay, Tuktoyaktuk, *10915.*

This is a northwestward extension of range of some 350 miles from near Norman Wells (Cody, 1960).

Agrostis scabra Willd. MRD: moist gravel in waste area, Inuvik, *13160.*

This species has not previously been recorded from north of Norman Wells (Cody, 1960); it is presumably introduced at Inuvik.

Hierochloe odorata (L.) Wahl. ELB: river bank, Anderson River, 69°16'N, 128°15'W, *12625.*

The map in Porsild (1957) indicates that in the northern part of its range this species has been collected in the Yukon at about 67°N latitude, about the western part of Great Bear Lake and at one disjunct locality on western Victoria Island in the western Arctic Archipelago. The species was rare at the Anderson River site and was not noted elsewhere in the region.

CYPERACEAE

Eleocharis acicularis (L.) R. & S. ELB: rare, in moss in partial shade at water's edge, south end of westernmost lake at mouth of Sitidgi Creek, *10745;* sterile among moss in 4 inches water in embayments cut off by sand spits at mouth of creek just north of Stanley Creek, west side of westernmost lake, *10695.*

Porsild (1943) noted this species as common in the Mackenzie River Delta and reported its occurrence at Kittigazuit on the Arctic Coast, but it has not previously been recorded from the Eskimo Lake Basin.

Carex bonanzensis Britton ELB: rare in sandy gravel of sand spit, south end of westernmost lake at mouth of Sitidgi Creek, *10744;* rare on low lake bank, outlet of Sitidgi Lake, *10810.*

Previously recorded from the East Branch of the Mackenzie River (Porsild, 1943), the range is now extended east into the Eskimo Lake Basin.

Carex aurea Nutt. MRD: among *Equisetum arvense* and *Hedysarum alpinum* in partial shade on bank of small creek, Williams Island, opposite Reindeer Station, *10890*.

This is a range extension of some 300 miles northwestward from Norman Wells (Cody, 1960).

JUNCACEAE

Juncus albescens (Lge.) Fern. AC: rare in wet spot on tundra with sedges and grasses, Toker Pt., *10332B*.

This collection helps complete our knowledge of the distribution of this species. The map in Porsild (1957) indicates that the nearest collections are from Banks and Victoria Islands, around Great Bear Lake, along the Canol Road through the Mackenzie Mountains and in Alaska. It was growing with *J. biglumis* at Toker Pt.

Luzula ? multiflora (Retz.) *Lej.* ELB: in moss on open scrubby tundra, Kugaluk River, 69°07′N, 130°52′W, *12570*.

This specimen which has the inflorescence leafy-bracted seems best referred to the *L. multiflora* complex although the nearest collections previously known are from Macmillan River in the Yukon Territory (Porsild, 1951) and the Horn Plateau in southeastern Mackenzie District.

ORCHIDACEAE

Cypripedium passerinum Richards. MRD: rare in open *Salix, Picea glauca* bush with *Arcostaphylos rubra, Hedysarum alpinum* etc. on silt of low ground by river, East Channel Mackenzie River, 3 miles northwest of Reindeer Station, *10090*.

This is a northwestward extension of range of some 300 miles from Norman Wells (Cody, 1960).

Cypripedium guttatum Sw. MRD: rare in shallow soil on limestone talus slope, Campbell Lake, *12725*.

This northwestern species is apparently quite rare in Mackenzie District. Hooker (1829-40) reported it as follows: "Two specimens only, with withered flowers, were gathered by Dr. Richardson at Fort Franklin, on the Mackenzie River . . .". Raup (1947) cites eight collections from Great Slave Lake, the Mackenzie Mountains and along the Mackenzie River as far north as Fort Norman. Porsild (1951) reported the occurrence of *C. guttatum* along the Yukon River, the Alaska-Yukon boundary at 65°58′N and 67°00′N in the Peel River Basin. Our collection is from some 300 miles northwest of Norman Wells from where I have seen a specimen (*Hutton, 4* (DAO)) and 160 miles northeast of the Peel River station. It is the northernmost station yet recorded on this continent.

SALICACEAE

Populus balsamifera L. MRD: scattered on higher ground among *Salix* in alluvial soil on islands, Williams Island, opposite Reindeer Station, *10037;* small grove of trees in protected spot in valley at base of hills, east bank of East Channel Mackenzie River, 68°55′N, 134°33′W, *9802;* ELB: on gravel spit, west side of westernmost Eskimo Lake, 68°45′N, 133°19′W, *10735;* near base of steep eroding bank, Portage Point, east side of westernmost Eskimo Lake, 68°46′N, 133°16′W, *10823;* additional collections from east of Anderson River: 16 miles southeast of the mouth of Hornaday River, on a creek flowing into it, *Ross Mackay s.n.*, Aug. 8, 1951 (DAO); west of the tree limit on the Horton River by about 15 miles, 67°42′N, 123°00′W, *Ross Mackay s.n.*, 1951 (DAO); along Brock River approx. 8 miles directly east of its mouth, *Ross Mackay s.n.*, 25 July 1951 (DAO).

Preble (1908) recorded this species as "lower Mackenzie and Peel rivers". On the Mackenzie River Delta islands opposite Reindeer Station, small groves of trees measuring up to 15 ft. in height with dbh 2½ inches were found on higher ground. Collection No. *9802* was from the first poplar stand noted when travelling south on the East Branch of the Mackenzie River; these trees measured 12 ft. in height with dbh 1½ inches. In the Eskimo Lake Basin *P. balsamifera* was noted only twice, and that on the westernmost lake: No. *10735* was from a grove of trees 2 to 25 ft. in height and No. *10823* from a group of trees to 8 ft. in height. It is of interest to note that east of the Anderson River *P. balsamifera* extends further north than *Picea*, the tree which is usually taken as the indicator of treeline. Dr. Mackay did not give the height of the trees from which his specimens were taken.

Salix farrae Ball ssp. *walpolei* Cov. & Ball.

Hultén (1941-52) in his Flora of Alaska and Yukon cites specimens of this entity

from Alaska Range District, Central Yukon River District and Bering Strait District, all in Alaska, and states in his text "Except from the above stations only known to me from Mackenzie Delta E. branch (*Porsild 6973*, sub. *S. Mackenzieana*)". Porsild (1951) made no mention of *S. farrae* ssp. *walpolei* in the intervening terrain. In the Mackenzie River Delta *S. farrae* ssp. *walpolei* occurs sporadically on alluvial soil on levees and flood plains above normal high water level. Specimens in the Department of Agriculture Herbarium (DAO) are from Aklavik, *9674;* Tihtaluh Channel, west side of delta, *R. Mackay 19;* East Channel: near Pete's Creek, *10356;* Williams Island, *10036, 10389;* 3 miles northwest of Reindeer Station, *10094;* and Reindeer Station, *12633.*

MYRICACEAE

Myrica gale L. ELB: shrub to 15 inches, rare on shore of small inland lake, 500 Lake, *10501.*

Porsild (1943) reported *M. gale* as rare at Campbell Lake on the east side of the Mackenzie River Delta. Our collection extends the known range eastward into the Eskimo Lake Basin.

CHENOPODIACEAE

Atriplex gmelinii C. A. Mey. AC: rare along gravel beach, Schooner Landing, mouth of Anderson River, 69°43′N, 138° 58′W, *10954.*

Not previously recorded from east of Kotzebue Sound in Alaska (Hultén, 1941-52); new to the flora of Mackenzie District. Our specimens are quite reduced in stature (1.0-8.0 cm), the stems are both branched and unbranched, stems and bracts are reddish and the leaves dark blackish green.

POLYGONACEAE

Rumex pallidus Bigel. AC: rare on gravel Beach, mouth of Anderson River, *10950.*

This is an eastward extension of range of some 125 miles from Kittigazuit (Porsild, 1943).

Polygonum aviculare L. *s.l.* MRD: common in trodden areas around settlement, Reindeer Station, *10960.*

Probably introduced; not previously recorded from north of Norman Wells (Cody, 1960).

Polygonum bistorta L. ssp. *plumosa* (Small) Hultén, *P. bistorta sensu* Macoun & Holm (1921) ELB: localized in deep mossy hummocks on slope, island on east side of second lake from west, 68°56′N, 132°56′W, *10548.*

Hultén (1941-52) reported ssp. *plumosa* as ". . . . N. Mackenzie District". This is presumably based on the Stringer specimen from Mackenzie River Delta cited by Macoun & Holm (1921). Our Eskimo Lake Basin station is thus the easternmost yet recorded for this species in Mackenzie District.

Polygonum alaskanum (Small) Wight var. *glabrescens* Hultén, *P. alpinum* var. *lapathifolium sensu* Raup (1947) and Porsild (1943) ELB: low eroding lake bank near mouth of Shelter Creek, west side of westernmost lake, 68°42′N, 133°04′W, *10822.*

Noted only once in the Eskimo Lake Basin, the easternmost known station; Porsild (1943) recorded this plant as common in the ravines on the East Branch of the Mackenzie River; about the Reindeer Station it has become quite weed-like; all the Mackenzie Delta specimens examined belong to var. *glabrescens.*

PORTULACACEAE

Montia lamprosperma Cham. ELB: in moss in 1 to 3 inches water along shore of small bay off lake, northwest shore of second lake from west, 68°54′N, 133°14′W, *10660.*

Not previously recorded from the mainland area between Shingle Point, Yukon Territory and Chesterfield Inlet on Hudson Bay but known from one locality on Victoria Island (Porsild, 1955); new to Mackenize District. Porsild suggests that this species might have been accidently distributed by the Eskimo at Chesterfield Inlet, Victoria Island and Shingle Point. This would certainly not seem to be the case in the Eskimo Lake Basin, which is remote from any Eskimo habitation.

CARYOPHYLLACEAE

Stellaria media (L.) Cyrill MRD: waste moist ground along street, Aklavik, *7886;* localized in dog yards, Reindeer Station, *13079.*

Introduced; not previously recorded from north of Norman Wells (Cody, 1960).

Cerastium arvense L. MRD: scattered on steep sand and gravel slope, Caribou Hills about 15 miles northwest of Reindeer Station.

Porsild (1943) recorded *C. arvense* from Campbell Lake and Great Bear Lake as new to the Northwest Territories. Our collection extends the known range of this species slightly to the northwest.

Arenaria physodes Fisch. in DC., *Merckia physodes* (Ser.) Cham. & Schlecht., *Wilhelmsia physodes* (Ser.) McNeill MRD: heavy soil, recently flooded lakeside 30 miles S of Aklavik, *W. E. Stevens, s.n.*, 15 July 1948 (DAO); moist sand among stones at back of beach, Summer Island northeast of Richards Island, 69°35′N, 133°55′, *13053;* AC: rare along gravel beach, Schooner Landing, mouth of Anderson River, 69°43′N, 138°58′W, *10955;* additional collection from east of Anderson River: south end of Darnley Bay east of mouth of Hornaday R., *Ross Mackay, s.n.*, 1951 (DAO).

Previously known from Mackenzie District only from a Stringer specimen collected at Mackenzie River Delta (Macoun & Holm, 1921). It is interesting to note that in the eastern part of its range in Alaska and the Yukon Territory this species is known only from the interior; Porsild (1939) however stated that *A. physodes* occurs in the salt marshes along the Bering Sea coast. It is strange then that there are no coastal collections from that part of Alaska and Yukon Territory between Bering Sea and the Mackenzie District sites. The Mackay specimen from Darnley Bay some 275 miles east of the Mackenzie River Delta is the easternmost yet recorded.

Arenaria lateriflora L. ELB: under *Salix* at back of beach, Crossley Lakes, 68°35′N, 129°30′W, *13112*.

Hultén (1941-52) recorded this plant *sub Moehringia lateriflora* ". . . over lower Mackenzie R. . . . ". The only other published indication of its occurrence in our area is in the map in Raup (1947). I have also collected *A. lateriflora* in silt along the banks of the East Branch and on the lower slopes of the Caribou Hills at the Reindeer Station.

Arenaria dawsonensis Britton MRD: shallow soil in crevice of limestone talus slope, Campbell Lake, 10 miles southeast of Inuvik, *12671*.

This is an extension of range of some 300 miles northwestward from Norman Wells. Porsild (1943) has collected it from Dease Arm and McTavish Arm of Great Bear Lake.

RANUNCULACEAE

Anemone drummondii Wats. MRD: rare on steep sand and gravel slope, Caribou Hills, East Channel Mackenzie River about 15 miles northwest of Reindeer Station, *9707;* shallow soil in crevice of limestone talus slope, Campbell Lake 10 miles southeast of Inuvik, *12684, 12685, 12686*.

With these collections the range of yet another cordillerian species is extended east of the Mackenzie River; the nearest collection is from King Point on the Arctic coast of Yukon Territory some 100 miles to the west; new to the flora of Mackenzie District. This species also occurs in high mountains as far south as Idaho and northern California where the type was collected.

Ranunculus flammula L., *R. reptans* L. MRD: lake bank in clay soil 30 miles S of Aklavik, *W. E. Stevens, s.n.*, 15 July 1948 (DAO). Although Hooker (1829-40) recorded *R. flammula* "Canada to lat. 69°", Raup (1947) saw no specimens from north of Lake Grant between Great Slave and Great Bear lakes. The northward range to near the Arctic Coast as given by Hooker is now substantiated.

Ranunculus sceleratus L. var. *multifidus* Nutt. MRD: one lush clump in water rooted in silt in roadside ditch, Aklavik, *12748*.

For many years the only record of this species from north of Great Slave Lake was the vague report in Hooker (1829-40) ". . . . from Canada to latitude 67°". in *Plants of the vicinity of Norman Wells* (Cody, 1960) I extended the range to the northwest some 425 miles from Great Slave Lake. The range is now extended a further 300 miles to the northwest of Norman Wells which is at 65°17′N latitude. It may however be introduced at Aklavik.

CRUCIFERAE

Capsella bursa-pastoris (L.) Medic MRD: waste ground of disturbed river bank, Inuvik, *12550*.

Introduced; not previously recorded from north of Norman Wells (Cody, 1960) but known from most settlements in southwestern Mackenzie District.

Erysimum cheiranthoides L. ELB: river bank, Anderson River, 69°16'N, 128° 15'W, *12622;* in humus in cabin clearing, Crossley Lakes, 68°35'N, 129°30'W, *13105.*

Hooker (1829-40) recorded this species ". . . . to latitude 67° on the Mackenzie", but otherwise unknown north of Norman Wells (Cody, 1960).

Arabidopsis mollis (Hook.) O. E. Schulz, *Arabis hookeri* Lange ELB: steep sand and gravel bank, east side of westernmost lake, 68°46'N, 133°16'W, *10834, 10857.*

Not previously recorded from the Eskimo Lake Basin.

Arabis divaricarpa A. Nels. MRD: rare on steep eroding middle and upper slopes of Caribou Hills, Reindeer Station, *9805, 10422;* AC: rare on grassy bank back from Stanley Creek, west side of westernmost lake, 68°46'N, 133°24'W, *10865.*

Our specimens are small in stature and have relatively few flowers so might be referred to var. *dacotica* (Greene) Boivin. Typical *A. divaricarpa* has been recorded by Raup (1947) from Fort Simpson some 600 miles to the southeast, where I have also collected it. The species apparently has not been collected in the intervening area but Raup (1936) does mention a Mackenzie River specimen without specific locality data, collected by Miss E. Taylor.

CRASSULACEAE

Sedum rosea (L.) Scop. ssp. *integrifolium* (Raf.) Hult.

There is one specimen, *Dutilly 18048* (DAO) labelled Aklavik. It seems rather doubtful if this plant would occur on the delta alluvium around Aklavik. Hultén (1941-52) gives the distribution of ssp. *integrifolium* as ". . . . America: from Alaska, Yukon, Mackenzie district (Pillage Pt.) W. Alberta . . .". Thus far I have been unable to locate Pillage Pt. in Mackenzie District.

ROSACEAE

Spiraea beauverdiana Schneider ELB: steep banks and occasionally on low *Betula glandulosa* flats, Anderson River, 69°16'N, 128°15'W, *12589.*

Porsild (1943) discussed the occurrence of *S. beauverdiana* in the Mackenzie River Delta and gave the easternmost limit as the second lake in the Eskimo Lake Basin. Our collection extends the known range eastward about 100 miles.

Potentilla norvegica L. ELB: localized in moist sand of sand spit, south end of westernmost lake at mouth of Sitidgi Creek, 68°41'N, 132°55'W, *10749.*

Hooker (1829-40) recorded this species "Throughout Canada; as far north as the Bear Lake". The map in Raup (1947) shows several collections from the Mackenzie River Delta, where I have also collected it, and from Fort Good Hope on the Mackenzie River. The only other far northern record is that of Cody (1960) from Norman Wells.

Potentilla anserina L. *s.l.* MRD: moist silt by river, Aklavik, *7920;* in silt of river bank above high water level, Reindeer Station, *10378.*

As at Norman Wells our specimens belong to that phase of the *Potentilla anserina* complex which Hultén has called *P. yukonensis.* These collections form an extension of the known range of some 300 miles northwestward from Norman Wells (Cody, 1960).

Potentilla palustris (L.) Scop MRD: waste moist ground along street, Aklavik, *7887;* common in wet ground around pond on lowland near river in partial shade of *Salix, Alnus crispa* and *Picea glauca,* Reindeer Station, *10395;* ELB: along moist shoreline and extending into shallow water of small inland lake, 500 Lake, 68°57'N, 132°34'W, *10502;* occasional in moist moss of streamlet, Moose Lake, 69°06'N, 130°37'W, *10133;* occasional among *Carex aquatilis* in wet sand at water's edge in protected bay of lake, northwest side of second lake from west, 68°54'N, 133°14'W, *10627;* occasional along gravel strand shoreline of island on east side of second lake from west, 68°56'N, 132°56'W, *10545;* common among sedge by small pond at lake level, east shore of westernmost lake, 68°47'N, 133°11'W, *10469;* rooted in sand among sedges at water's edge at mouth of small creek just north of Stanley Creek, 68°48'N, 133° 24'W, *10711;* rare among *Carex aquatilis*

along bay shore, south end of westernmost lake at mouth of Sitidgi Creek, 68°41'N, 132°55'W, *10762;* AC: common but sterile among sedges and grasses at end of small inland lake, Toker Point, 69°38'N, 132° 54'W, *10343.*

This species was recorded by Hooker (1829-40) ". . . as far north as Bear Lake". Raup (1947) confirmed the Bear Lake citation by recording a specimen collected by *J. M. Bell.* The northernmost known locality along the Mackenzie River was Norman Wells (Cody, 1960). The present collections indicate that *P. palustris* is fairly common in suitable habitats even as far north as Toker Point on the Arctic Coast. This latter collection represents a range extension of some 350 miles northwest from Norman Wells.

LEGUMINOSAE

Astragalus richardsonii Sheldon, *A. vaginatus* Richards. *non* Pallas, *A. aboriginorum sensu* A. A. incl. Cody (1954) MRD: rare in sand at top of bank overlooking small lake, Kidluit Bay, northeast side of Richards Island, *10190;* common in sandy soil at south end of island 'Gull Island' in Kidluit Bay, *9982;* additional collection from east of Anderson River: about 15 miles west of Horton River and from 15-20 miles from the barren grounds, 67°42'N, 123°00,'W, *Ross Mackay, s.n.,* July 1951.

Porsild (1955) clearly demonstrated that this Arctic Canadian species which has long been erroneously referred to *A. aboriginorum* should correctly be called *A. richardsonii* Sheldon. Later he (Porsild, 1957) published a map of the distribution of this species as known to him. The specimens cited here extend the known range westward to the Mackenzie River Delta, a distance of some 275 miles from the nearest known locality on Banks Island.

Hedysarum alpinum L. appg. var. *grandiflorum* Rollins MRD: scattered on steep sand bank overlooking river, Old Army Camp, East Channel Mackenzie River, 69°17'N, 133°54'W, *9774;* south-facing sandy slope, south side Summer Island, northeast of Richards Island, 69°31'N, 133°48'W, *10008.*

Our specimens measure in height from 1.5 to 2.6 dm, the inflorescence is less elongate than specimens from the Mackenzie Valley, and the somewhat darker flowers measure from 1.5 to 1.7 cm. Hultén (1941-52) has referred a coastal Yukon Territory specimen as well as a number of Alaskan collections to var. *grandiflorum.* This is, however, far beyond the range outlined by Rollins (1955).

Lathyrus japonicus Willd. var. *japonicus* MRD: rare on steep sand and gravel bank, Caribou Hills, East Channel Mackenzie River about 15 miles northwest of Reindeer Station *9695.*

Our specimen is glabrous or nearly so and hence should be referred to var. *japonicus;* pubescent specimens from Coppermine, Bathurst Inlet and other points along the Arctic Coast of Mackenzie District have been referred to var. *aleuticus* (Greene) Fern.

HIPPURIDACEAE

Hippuris vulgaris L. MRD: in muck and shallow water around small lake, Aklavik, *7909;* ELB: in 1 foot water, a few small patches in embayments cut off by sand spits at mouth of Stanley Creek, west side of westernmost lake, 68°48'N, 133°24'W, *10694;* rare in 8 inches water of small bay rooted in muck, south end of westernmost lake at mouth of Sitidgi Creek, 68°41'N, 132°55'W, *10793;* rooted in muck in 1 foot water of small bay off lake, northwest shore of second lake from west, 68°54'N, 133°14'W, *10659;* occasional in muck in 5 inches water of small bay, island at east end of second lake from west, 68°57'N, 132°54'W, *10582;* AC: common in 6-15 inches water in small lake behind sand dunes, Toker Point, *10309;* in shallow water, 1-6 inches, rooted in sandy ground at edge of small lake half a mile back of seashore, Warren Pt., *10203.*

Hooker (1829-40) recorded this species only to 60° latitude. Recently the species was reported (Cody 1960) from Norman Wells at latitude 65°17'N. The present collections represent an extension of some 350 miles to the Arctic Coast.

Hippuris tetraphylla L. f. MRD: in shallow water rooted in muck bordering several small ponds near shore, Kidluit Bay, northeast side of Richards Island,

10160; AC: in shallow water among grasses and sedges at edge of small lake back of sea shore, Tuktoyaktuk, *9898*.

Previously known along the arctic coast of Yukon Territory at Shingle Pt. (Porsild, 1943); new to the flora of Mackenzie District.

PYROLACEAE

Pyrola virens Schweigg. MRD: moist moss slope among *Picea mariana,* rare, Campbell Lake 10 miles southeast of Inuvik, *12661*.

Not previously recorded from north of Sans Sault Rapids on the Mackenzie River (Raup, 1947) some 200 miles to the southeast.

ERICACEAE

Arctostaphylos uva-ursi (L.) Spreng. MRD: Prostrate shrub rooted in shallow soil on stoney slope by lake near airstrip, Inuvik, *9837;* prostrate shrub forming extensive patches near top of steep sand and gravel slope, Caribou Hills, about 15 miles northwest of Reindeer Station, *9718;* ELB: prostrate on grassy bank back from Stanley Creek, west side of westernmost lake, 68°46′N, 133°24′W, *10869*.

Although reported by Preble (1908) ". . . throughout the territory covered by our observations, and . . . also into the Barren Grounds", the northernmost locality with accurate data previously recorded was Norman Wells (Cody, 1960).

PRIMULACEAE

Primula borealis Duby forma **albiflora** forma nova, a forma typica differt corollis albis AC: elevation 2 ft., Oil Drum Island, Anderson River Delta, 69° 42′ N, 129° 00′ W, *T. W. Barry, 290* (DAO, type).

This white-flowered form was found growing with the typical lilac-coloured at this locality.

SCROPHULARIACEAE

PRIMULACEAE

Primula borealis Duby forma *albiflora* forma nvo, a forma typica differt corollis albis AC: elevation 2 ft., Oil Drum Island, Anderson River Delta, 69°42′N, 129°00′W, *T. W. Barry, 290* (DAO, type).

This white-flowered form was found growing with the typical lilac-coloured at this locality.

Pedicularis lanata Cham. & Schl. f. *alba* Cody MRD: one plant growing with the typical form on hummocky tundra, top of Caribou Hills behind Reindeer Station, *9817*.

Not previously recorded from Mackenzie District, but certainly to be expected to occur sporadically anywhere the typical form might be found.

COMPOSITAE

Erigeron angulosus Gaudin var. *kamtschaticus* (DC.) Hara, *E. acris* L. var. *asteroides* (Andrz.) DC. MRD: disturbed ground along road, Aklavik, *7922;* ELB: rare in moist sand of sand spit, west side of westernmost lake, 68°46′N, 133°24′W, *10718*.

Not previously recorded from north of Norman Wells (Cody, 1960) and Great Bear Lake (Raup, 1947), and thus a range extension of some 300 miles to the northwest.

Antennaria isolepis Greene MRD: shallow soil in crevice of limestone talus slope, Campbell Lake 10 miles southeast of Inuvik, *12688*.

The map in Porsild (1950) shows the nearest known collections as from about Great Bear Lake and along the Canol Road in the Mackenzie Mountains. Our collection is thus a northward extension of range of some 300 miles.

Matricaria matricarioides (Less.) Porter MRD: a single plant by roadside, Aklavik, *7900*.

Introduced; not previously recorded from north of Norman Wells (Cody, 1960); although this may be only a casual introduction at this time, it seems inevitable from the manner in which *M. matricarioides* has spread around other Mackenzie Valley settlements, that it will soon become well established here.

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ADDITIONS TO THE FLORA OF GROSSE-ILE, QUEBEC

JOHN J. SEXSMITH
Research Station, Canada Department of Agriculture,
Lethbridge, Alberta

GROSSE-ILE IS LOCATED IN THE ST. LAWRENCE RIVER about six miles east of the Ile d'Orleans and approximately 30 miles downstream from Quebec City. The author was stationed on the island from August 1943 to December 1944 while serving with the Canadian Army. During this time he collected a number of the vascular plants growing on the island. Collection was limited because of the lack of facilities for drying and storing, with the result that most species familiar to one from Western Canada were identified and noted but not saved. Some genera, such as *Sparganium*, *Juncus*, *Equisetum*, *Salix* and *Viola*, were disregarded, and only a few of the more common species of *Scirpus* and *Carex* were considered.

The physical features of Grosse-Ile were described and the salient ecological information was given, along with a species inventory, by Marie-Victorin and Meilleur (1939). They based their observations on three short visits to the island in 1922, 1925, and 1935.

One hundred and ninety-one of the species listed by Marie-Victorin and Meilleur (1939) are also included in the present listing. This is considered desirable because the earlier authors did not differentiate between species they collected and those they only observed and recorded. All species listed below that are not represented by pressed specimens and not mentioned by Marie-Victorin and Meilleur (1939) were identified by the present author and also by Mr. R. P. Hanson, who in 1943 and 1944 was serving with the U.S. Army on Grosse-Ile.

Some of the herbaceous perennials herein included are domestic plants that had persisted in and around the garden areas of houses abandoned prior to 1935 (e.g., *Iris germanica* L., *Hemerocallis fulva* L., *Narcissus poeticus* L., and *Rheum Rhaponticum* L.). A few other species, seen but not listed, doubtless were recent introductions due to the various activities of Army personnel. Included in this category would be *Triticum aestivum* L., *Hordeum vulgare* L., *Avena sativa* L., *Solanum tuberosum* L., and *Lycopersicum esculentum* Mill.

The order in which the families are listed follows that of Marie-Victorin (1935). The species names as given by Marie-Victorin (1935) are used for all but a few species not included in his flora, and for these exceptions the identity given by Fernald (1950) is used. Of the 418 species named below, 227 do not appear in the list of Marie-Victorin and Meilleur (1939) and 146 of these are represented by preserved specimens.

*Specimen in personal herbarium of author, located at the Research Station, Lethbridge, Alberta.
S–Identified but no specimen obtained.
V–Listed by Marie-Victorin and Meilleur (1939).

LYCOPODIACEAE

* V *Lycopodium annotinum* L.
* V ,, *clavatum* L.
* V ,, *flabelliforme* (Fern.) Blanchard
* *Lycopodium lucidulum* Michx.
* V ,, *obscurum* L.

SELAGINELLACEAE

S V *Selaginella rupestris* (L.) Spring.

ISOETACEAE

* *Isoetes* sp.

OSMUNDACEAE

S *Osmunda cinnamomea* L.

POLYPODIACEAE

* *Athyrium angustum* (Willd.) Presl
* V *Dennstaedtia punctilobula* (Michx.) Moore
* *Onoclea sensibilis* L.
* V *Polypodium virginianum* L.
* *Polystichum Braunii* (Spenner) Fee
* *Pteridium latiusculum* (Desv.) Hieron.
* V *Thelypteris marginalis* (L.) Nieuwl.
* ,, *Phegopteris* (L.) Slosson
* V ,, *spinulosa* (O. F. Mueller) Nieuwl.
* *Thelypteris spinulosa* (O. F. Mueller) Nieuwl. var. *intermedia* Nieuwl.
* V *Woodsia ilvensis* R. Br.

TAXACEAE

S V *Taxus canadensis* Marsh.

CUPRESSACEAE

S V *Juniperus communis* L. var. *depressa* Pursh
S V *Juniperus horizontalis* Moench
* V *Thuja occidentalis* L.

ABIETACEAE

* V *Abies balsamea* (L.) Mill.
S V *Picea glauca* (Moench.) Voss
S *Picea mariana* (Mill.) BSP.
S V *Pinus Strobus* L.
S V *Tsuga canadensis* (L.) Carr.

BETULACEAE

S *Alnus incana* (L.) Willd.
* *Betula lutea* Michx. f.

S V *Betula papyrifera* Marsh.
* V *Corylus cornuta* Marsh.
* V *Ostrya virginiana* (Mill.) Willd.

FAGACEAE

* V *Quercus borealis* Michx. f.

MYRICACEAE

* *Myrica Gale* L.

JUGLANDACEAE

S V *Juglans cinerea* L.

SALICACEAE

* *Populus grandidentata* Michx.
S V ,, *tacamahacca* Mill.
S V ,, *tremuloides* Michx.

ULMACEAE

S V *Ulmus americana* L.

URTICACEAE

S *Humulus Lupulus* L.
* V *Laportea canadensis* (L.) Gaud.
S *Urtica procera* Willd.

POLYGONACEAE

* *Polygonum arifolium* L.
S V ,, *aviculare* L.
* V ,, *cilinode* Michx.
S V ,, *Convolvulus* L.
* ,, *Hydropiper* L.
* ,, *lapathifolium* L.
* ,, *pennsylvanicum* L.
* ,, *Persicaria* L.
* ,, *punctatum* Ell.
* ,, *sagittatum* L.
S *Rheum Rhaponticum* L.
* *Rumex Acetosa* L.
S ,, *Acetosella* L.
S ,, *crispus* L.
S ,, *occidentalis* S. Wats.

CHENOPODIACEAE

S V *Atriplex hastata* L.
S V *Axyris amaranthoides* L.
S *Chenopodium album* L.
S ,, *capitatum* L.
* ,, *hybridum* L. var. *gigantospermum* (Aellen) Rouleau

AMARANTHACEAE

S *Amaranthus retroflexus* L.

PORTULACACEAE

* *Claytonia caroliniana* L.
S *Portulaca oleracea* L.

CARYOPHYLLACEAE

S *Cerastium vulgatum* L.
* V *Sagina procumbens* L.
S *Saponaria officinalis* L.
* *Silene Cucubalus* Wibel
S V *Silene noctiflora* L.
* *Spergula arvensis* L.
S *Stellaria graminea* L.
S *Stellaria media* (L.) Cyrill.

EUPHORBIACEAE

* *Euphorbia Helioscopia* (L.) Hill

RANUNCULACEAE

S V *Actaea alba* (L.) Miller
* ,, *pachypoda* Ell.
S V ,, *rubra* (Ait.) Willd.
S *Anemone canadensis* L.
* *Aquilegia canadensis* L.
S *Caltha palustris* L.
* *Clematis virginiana* L.
* *Coptis groenlandica* Oeder
* *Ranunculus abortivus* L.
S V ,, *acris* L.
* ,, *Cymbalaria* Pursh
* ,, *recurvatus* Poir.
* V ,, *repens* L.
* ,, *reptans* L.
S *Thalictrum polygamum* Muhl.

BERBERIDACEAE

S *Berberis vulgaris* L.
S *Berberis Thunbergii* DC.

FUMARIACEAE

* V *Corydalis sempervirens* (L.) Pers.
* *Dicentra Cucullaria* (L.) Torr.

PAPAVERACEAE

* V *Sanguinaria canadensis* L.

CRUCIFERACEAE

* *Arabis Drummondii* A. Gray
S *Barbarea orthoceras* Ledeb.
* *Barbarea vulgaris* R. Br.
S *Brassica arvensis* (L.) Ktze.
* *Bunias orientalis* L.
S *Capsella Bursa-pastoris* (L.) Medic.
* *Cardamine pennsylvanica* Muhl.
* V *Draba arabisans* Michx.
* V *Erysimum cheiranthoides* L.
S *Lepidium densiflorum* Schrad.
* *Rorippa palustris* (L.) Bess. var. *glabrata* (Lunell) Vict.
* *Rorippa palustris* (L.) Bess. var. *hispida* (Desv.) Rydb.
S *Sisymbrium altissimum* L.
S *Thlaspi arvense* L.

DROSERACEAE

* V *Drosera intermedia* Hayne
* *Drosera rotundifolia* L.

HYPERICACEAE

* V *Hypericum ellipticum* Hook.
* ,, *mutilum* L.
* V ,, *perforatum* L.
* V ,, *punctatum* Lam.
* ,, *virginicum* L.

CRASSULACEAE

* V *Sedum acre* L.

S *Sedum purpureum* Tausch.
* *Tillaea aquatica* L.

SAXIFRAGACEAE

* V *Chrysosplenium americanum* Schwein.
* *Ribes glandulosum* Grauer
S V *Ribes hirtellum* Michx.
S V *Saxifraga virginiensis* Michx.

ROSACEAE

* *Agrimonia gryposepala* Wallr.
S *Agrimonia striata* Michx.
* *Alchemilla pratensis* F. W. Schmidt
S V *Aronia melanocarpa* (Michx.) Britton
S V *Crataegus* sp.
S *Fragaria virginiana* Duchesne
S *Geum macrophyllum* Willd.
* V *Physocarpus opulifolius* (L.) Raf.
* *Potentilla Anserina* L.
* V ,, *argentea* L.
S ,, *norvegica* L.
* ,, *palustris* L.
* V ,, *tridentata* Soland.
S V *Prunus pennsylvanica* L. f.
S V *Prunus virginiana* L.
S V *Rosa blanda* Ait.
S *Rosa carolina* L.
S V *Rubus Idaeus* L. var. *strigosus* (Michx.) Maxim.
S *Rubus pergratus* Blanchard
* *Rubus pubescens* Raf.
* V *Sanguisorba canadensis* L.
S V *Sorbus americana* Marsh.
* V *Spiraea latifolia* (Ait.) Borkh.

LEGUMINOSAE

* *Amphicarpaea bracteata* (L.) Fernald
* V *Astragalus canadensis* L.
* V *Astragalus labradoricus* DC.
* V *Desmodium canadense* DC.
* *Lathyrus palustris* L.
* *Lathyrus palustris* L. var. *linearifolius* Ser.
* V *Lathyrus pratensis* L.
S *Medicago lupulina* L.
S V *Melilotus alba* Desr.
S *Melilotus officinalis* (L.) Lam.
* *Trifolium agrarium* L.
S ,, *hybridum* L.
S V ,, *pratense* L.
S V ,, *repens* L.
S *Vicia angustifolia* L.
* V ,, *Cracca* L.
* V ,, *tetrasperma* (L.) Moench

LYTHRACEAE

* V *Lythrum Salicaria* L.

ONAGRACEAE

* V *Circaea alpina* L.
* *Circaea latifolia* Hill
S *Epilobium angustifolium* L.
S V ,, *ecomosum* (Fassett) Fernald
S V ,, *glandulosum* Lehm. var. *adenocaulon* (Haussk.) Fernald
S V *Epilobium glandulosum* Lehm. var. *occidentale* (Trelease) Fernald
* *Oenothera perennis* L.

MALVACEAE

S V *Malva moschata* L.
S *Malva rotundifolia* L.

TILIACEAE

* V *Tilia glabra* Vent.

OXALIDACEAE

* *Oxalis europaea* Jord.
* *Oxalis montana* Raf.

GERANIACEAE

* V *Geranium Robertianum* L.

ANACARDIACEAE

S V *Rhus Toxicodendron* L.
S V *Rhus typhina* L.

ACERACEAE

* V *Acer pennsylvanicum* L.
* V ,, *rubrum* L.
* V ,, *saccharum* Marsh.
* V ,, *spicatum* Lam.

LIMNANTHACEAE

S *Floerkea proserpinacoides* Willd.

BALSAMINACEAE

* *Impatiens biflora* Walt.

AQUIFOLIACEAE

* *Ilex verticillata* (L.) A. Gray
* *Nemopanthus mucronata* (L.) Trel.

VITACEAE

S V *Parthenocissus quinquefolia* (L.) Planch.
* *Vitis vulpina* L.

CORNACEAE

* V *Cornus alternifolia* L. f.
* ,, *canadensis* L.
* V ,, *rugosa* Lam.
S ,, *stolonifera* Michx.

ARALIACEAE

* V *Aralia hispida* Vent.
* ,, *nudicaulis* L.
* ,, *racemosa* L.

UMBELLIFERAE

S *Carum Carvi* L.
S *Cicuta maculata* L.
S V *Heracleum lanatum* Michx.
* V *Hydrocotyle americana* L.
* *Osmorrhiza obtusa* Fernald
* V *Sium suave* Walt.
* V *Zizia aurea* (L.) Koch

PRIMULACEAE

* *Lysimachia terrestris* (L.) BSP.
* *Steironema ciliatum* (L.) Raf.
* *Trientalis borealis* Raf.

ERICACEAE

S *Arctostaphylos Uva-Ursi* (L.) Spreng.
* *Chimaphila umbellata* (L.) Pursh
* *Chiogenes hispidula* (L.) T. & G.
* V *Epigaea repens* L.
* *Gaultheria procumbens* L.
* V *Monotropa uniflora* L.
* *Vaccinium canadense* Kalm
* V *Vaccinium pennsylvanicum* Lam.

CONVOLVULACEAE

* *Convolvulus arvensis* L.
* *Convolvulus sepium* L.

POLEMONIACEAE

S V *Collomia linearis* Nutt.

BORAGINACEAE

S V *Cynoglossum officinale* L.
* *Echium vulgare* L.
S V *Lappula echinata* Gilib.
S V *Lithospermum officinale* L.
* *Lycopsis arvensis* L.
* *Myosotis arvensis* (L.) Hill.

SOLANACEAE

* *Physalis heterophylla* Nees

SCROPHULARIACEAE

* *Chelone glabra* L.
* V *Euphrasia canadensis* Townsend
* V *Gerardia paupercula* (A. Gray) Britton var. *borealis* Pennell
* *Ilysanthes dubia* (L.) Barnh.
* V *Limosella subulata* Ives
S V *Linaria vulgaris* Mill.
* V *Melampyrum lineare* Desr. var. *latifolium* (Muhl.) Beauverd
* *Mimulus moschatus* Dougl.
* *Mimulus ringens* L.
* *Pedicularis palustris* L.
* V *Scrophularia lanceolata* Pursh
S *Verbascum Thapsus* L.
* V *Veronica peregrina* L.
* V ,, *persica* Poir.
* V ,, *serpyllifolia* L.
* ,, *scutellata* L.

OROBANCHACEAE

* *Orobanche uniflora* L.

VERBENACEAE

* V *Verbena hastata* L.

LABIATAE

S *Dracocephalum parviflorum* Nutt.
* V *Galeopsis Ladanum* L.
* *Galeopsis Tetrahit* L.
* *Glechoma hederacea* L.
* *Lycopus americanus* Muhl.
* V *Lycopus uniflorus* Michx.
* *Mentha canadensis* L.
* *Mentha canadensis* L. var. *glabrata* Benth.
* *Mentha spicata* L.
* V *Nepeta Cataria* L.
* *Prunella vulgaris* L.
* *Pycnanthemum virginianum* (L.) Durand & Jackson
* V *Satureja vulgaris* (L.) Fritsch.
* V *Scutellaria epilobiifolia* A. Ham.
* ,, *lateriflora* L.
* V ,, *parvula* Michx.
* V *Stachys aspera* Michx.
* *Stachys palustris* L.
* *Teucrium occidentale* A. Gray var. *boreale* (Bickn.) Fernald

PLANTAGINACEAE

* V *Plantago juncoides* Lam. var. *decipiens* (Barneoud) Fernald
S V *Plantago lanceolata* L.
S *Plantago major* L.

GENTIANACEAE

* V *Gentiana Victorinii* Fernald
* *Halenia deflexa* (J. E. Smith) Griseb.
* V *Menyanthes trifoliata* L. var. *minor* Michx.

APOCYNACEAE

* *Apocynum cannabinum* L.

ASCLEPIADACEAE

S V *Asclepias incarnata* L.
S V *Asclepias syriaca* L.

OLEACEAE

S V *Fraxinus americana* L.
S *Syringa vulgaris* L.

RUBIACEAE

* V *Galium Claytoni* Michx.
* V ,, *palustre* L.
* ,, *triflorum* Michx.
* ,, *verum* L.

CAPRIFOLIACEAE

* *Diervilla Lonicera* Mill.
* *Linnaea borealis* L.
* V *Lonicera canadensis* Marsh.
S *Lonicera tatarica* L.
* V *Sambucus canadensis* L.
S *Sambucus pubens* Michx.
* V *Triosteum aurantiacum* L.
* *Viburnum cassinoides* L.
* V *Viburnum trilobum* Marsh.

CAMPANULACEAE

S *Campanula rapunculoides* L.
* V *Campanula rotundifolia* L.

LOBELIACEAE

* *Lobelia inflata* L.
* V *Lobelia Kalmii* L.

COMPOSITAE

* V *Achillea millefolium* L.
* V *Achillea Ptarmica* L.
* V *Ambrosia artemisiifolia* L.

* V *Anaphalis margaritacea* (L.) Benth.
* *Anthemis Cotula* L.
S V *Arctium minus* (Hill) Bernh.
S V *Artemisia biennis* Willd.
S *Artemisia vulgaris* L.
* V *Aster acuminatus* Michx.
* ,, *novi-belgii* L.
S V ,, *paniculatus* Lam.
* *Bidens comosa* (A. Gray) Wiegand
* ,, *Eatoni* Fernald
* V ,, *frondosa* L.
* V *Centaurea nigra* L.
* *Chrysanthemum Leucanthemum* L.
S *Cichorium Intybus* L.
S V *Cirsium arvense* (L.) Scop.
* V *Erechtites hieracifolia* (L.) Raf.
S *Erigeron canadensis* L.
S *Erigeron philadelphicus* L.
* V *Eupatorium maculatum* L.
* V ,, *perfoliatum* L.
* V ,, *urticaefolium* Reichard
* *Gnaphalium uliginosum* L.
* V *Helenium autumnale* L.
* V *Helianthus subtuberosus* Bourgeau
* V *Hieracium aurantiacum* L.
* V ,, *Pilosella* L.
* V ,, *vulgatum* Fries
* V *Lapsana communis* L.
* V *Leontodon autumnalis* L.
* *Matricaria inodora* L.
S *Matricaria matricarioides* (Less.) Porter
S *Prenanthes trifoliata* (Cass.) Fernald
S *Senecio vulgaris* L.
* V *Solidago canadensis* L.
* V ,, *graminifolia* (L.) Salisb.
* V ,, *hispida* Muhl.
* ,, *latifolia* L.
* V ,, *rugosa* Mill.
* V ,, *squarrosa* Muhl.
S *Sonchus arvensis* L.
S ,, *asper* (L.) Mill.
S ,, *oleraceus* L.
* *Tanacetum vulgare* L.
S *Taraxacum officinale* Weber
S *Tragopogon pratensis* L.

ALISMACEAE

* V *Alisma Plantago-aquatica* L. var. *brevipes* (Greene) Sam.
* *Sagittaria heterophylla* Pursh
* *Sagittaria latifolia* Willd.

BUTOMACEAE

* V *Butomus umbellatus* L.

SCHEUCHZERIACEAE

* *Triglochin maritima* L.
S *Triglochin palustris* L.

NAJADACEAE

* *Potamogeton Richardsonii* (A. Bennett) Rydb.
* *Potamogeton Spirillus* Tuckerman

LILIACEAE

* V *Allium Schoenoprassum* L. var. *sibiricum* (L.) Hartm.
* V *Allium tricoccum* Soland.
S *Asparagus officinalis* L.
* *Clintonia borealis* (Ait.) Raf.
S *Hemerocallis fulva* L.
* *Maianthemum canadense* Desf.
* V *Medeola virginiana* L.
* V *Polygonatum pubescens* (Willd.) Pursh
* *Smilacina racemosa* (L.) Desf.
* V *Trillium erectum* L.
* ,, *grandiflorum* Michx.
* V ,, *undulatum* Willd.
S V *Veratrum viride* Ait.

AMARYLLIDACEAE

S *Narcissus poeticus* L.

IRIDACEAE

S *Iris germanica* L.
* V *Iris versicolor* L.
S V *Sisyrinchium angustifolium* Miller

CYPERACEAE

* *Carex projecta* Mack.
* ,, *pseudo-Cyperus* L.
* ,, *Tuckermani* Dewey
* *Cyperus rivularis* Kunth
S V *Scirpus cyperinus* (L.) Kunth

GRAMINEAE

S *Agropyron repens* (L.) Beauv.
* *Agropyron trachycaulum* (Link) Malte var. *unilaterale* (Cassidy) Malte
* V *Agrostis borealis* Hartm.
* V ,, *maritima* Lam.
* ,, *perennans* (Walt.) Tuckerm.
* V ,, *scabra* Willd.
* ,, *stolonifera* L.
* V *Andropogon furcatus* Muhl.
S *Avena fatua* L.
S *Bromus inermis* Leyss.
* *Calamagrostis canadensis* (Michx.) Beauv.
S *Dactylis glomerata* L.
* V *Danthonia spicata* (L.) Beauv.
* V *Deschampsia caespitosa* (L.) Beauv.
* V *Deschampsia flexuosa* (L.) Trin.
* *Echinochloa Crus-galli* (L.) Beauv.
* *Elymus virginicus* L.
S *Festuca elatior* L.
* V *Festuca rubra* L.
* *Glyceria canadensis* (Michx.) Trin.
* *Glyceria striata* (Lam.) Hitchc.
S *Hierochloë odorata* (L.) Wahl.
S *Leersia oryzoides* (L.) Swartz
* V *Muhlenbergia foliosa* (R. & S.) Trin. var. *setiglumis* (S. Wats.) Scribn.
* V *Muhlenbergia racemosa* (Michx.) BSP.
* *Muhlenbergia sylvatica* Torr.
* V *Panicum boreale* Nash
* *Panicum capillare* L.
S V *Phleum pratense* L.

S V *Poa annua* L.
S ,, *compressa* L.
* ,, *palustris* L.
S ,, *pratensis* L.
* *Setaria lutescens* (Weigel.) Hubb.
S *Setaria viridis* (L.) Beauv.
* V *Spartina pectinata* Bosc.
* *Trisetum spicatum* (L.) Richter
* *Zizania palustris* L.

ORCHIDACEAE

* *Corallorrhiza maculata* Raf.
* *Cypripedium acaule* L.
* *Goodyera repens* (L.) R. Br.
* *Habenaria orbiculata* (Pursh) Goldie
* V *Habenaria psycodes* (L.) Sw.
* *Malaxis unifolia* Michx.
* V *Spiranthes Romanzoffiana* Cham. & Schlecht.

ARACEAE

* V *Acorus Calamus* L.
* *Arisaema atrorubens* (Ait.) Blume forma *zebrinum* (Sims) Fernald
* V *Arisaema triphyllum* (L.) Schott.
* V *Calla palustris* L.
S V *Symplocarpus foetidus* (L.) Salisb.

TYPHACEAE

S *Typha latifolia* L.

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ADDITIONS TO THE KNOWN RANGE OF SOME AMPHIBIANS AND REPTILES IN SASKATCHEWAN

FRANCIS R. COOK
National Museum of Canada, Ottawa, Ontario

COLLECTIONS AND REPORTS obtained during studies of the reptiles and amphibians of the Prairie Provinces for the National Museum of Canada in 1959-1963 have provided new information on the distribution of many species. As the comprehensive report planned for this area will be delayed until further field studies have been completed, some of the more noteworthy distribution records are recorded here. New records for seven species, *Ambystoma tigrinum*, *Scaphiopus bombifrons*, *Rana sylvatica*, *Chelydra s. serpentina*, *Chrysemys picta belli*, *Thamnophis elegans vagrans*, and *Crotalus v. viridis*, in Saskatchewan are reported. For the first three species only peripheral range records are considered, but due to the paucity of localities for the others, all records are cited. Possible limiting factors for some of these species in Saskatchewan are discussed, and observations on time of breeding and egg laying are included when available. It is hoped that publication of this information will encourage the reporting of additional observations from Saskatchewan, either by publication or direct communication with the writer.

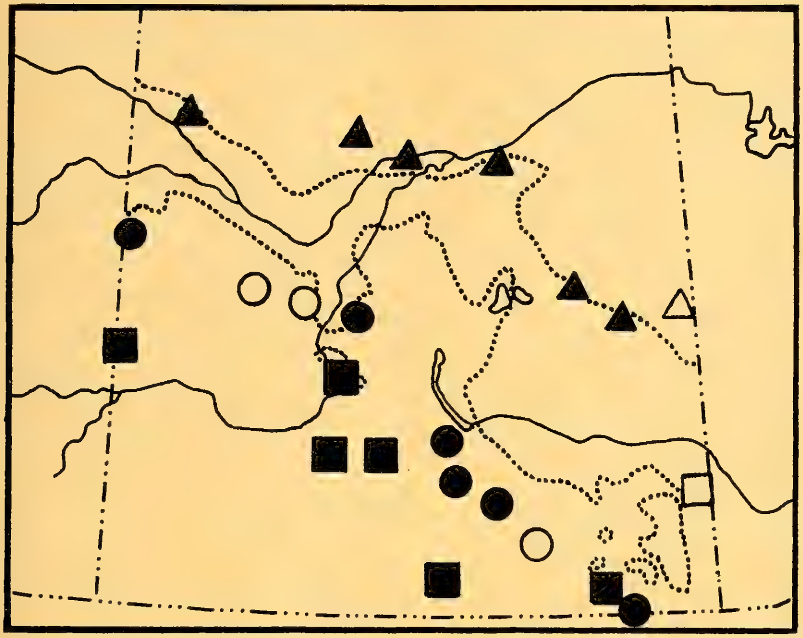

FIGURE 1. Outline map of southern Saskatchewan showing location of records given in the text for *Ambystoma tigrinum* (triangles), *Scaphiopus bombifrons* (squares), and *Rana sylvatica* (circles). Museum specimens are shown by solid symbols; reports, sight records and auditory records by hollow symbols. The dotted lines are the predominantly boreal forest—forest and grassland (aspen parkland) division (top dotted line) and the transition—grassland division (bottom dotted line) according to Rowe, 1959. In some cases a symbol marks the location of more than one record.

The following abbreviations are used for museum specimens: NMC, National Museum of Canada; SMNH, Saskatchewan Museum of Natural History; US, University of Saskatchewan.

Ambystoma tigrinum, TIGER SALAMANDER

As all the records reported here are based on collections of larvae, and therefore are unsuitable for subspecies allocation, consideration of the problem of the distribution of the two races of *A. tigrinum* in Saskatchewan is deferred until a later paper when additional material is available. Cook (1960) reported the northern limit of the Tiger Salamander as Prince Albert, in the central part of the province. Subsequent collecting has yielded northern localities to the east and west of Prince Albert. The approximate northern limit is delimited by the following collections, arranged from west to east: 1.9 miles northwest on Hwy. 26 of Cleeves, July 2, 1962 (NMC 6197); 0.7 mi. N. on Hwy. 55 of Polwarth, July 7, 1962 (NMC 6253); Prince Albert, June 22, 1959 (NMC 4070) July 25, 1959 (NMC 4081); Gronlid, July 16, 1962 (NMC 6351); Lintlaw, July 12, 1962 (NMC 6329); 3.7 mi. N. on Hwy. 9 of Canora, July 12, 1962 (NMC 6320). These localities are shown in Figure 1. Also shown is a sight record of larvae and adults provided by local farmers approximately one mile east of Arran near the Saskatchewan-Manitoba border July 18, 1962.

At its northern limit, *A. tigrinum* reaches, but does not penetrate, the southern edge of the continuous coniferous boreal forest. The southern limit of the predominantly coniferous forest area according to Rowe (1959) is shown in Figure 1. All *A. tigrinum* collections listed above were taken from ponds and dugouts in aspen parkland (boreal-grassland

transition of Rowe, 1959) habitat. The slight penetrations north of Rowe's line are due to the presence at these localities of aspen parkland areas which are continuous with those to the south. Field work in adjacent coniferous forest has failed to reveal salamanders. In Saskatchewan, the species is common to abundant throughout the aspen parkland and grassland zones. Some factor in the coniferous boreal forest habitat, rather than temperature, seems to prevent the spread of this species farther north. This may be unsuitable soil conditions for the burrowing adults or a lack of suitable breeding ponds.

Little is known about the breeding time of this species in western Canada. Only two collections of eggs have been taken: 3 miles east of Zealandia, May 9, 1961 (NMC 5242) and Pike Lake, May 6, 1962 (NMC 5995). The first locality was a dugout pond in which the eggs had been laid in 12 to 14 inches of water and were attached to grass stems 3 to 4 inches below the surface. The eggs were laid singly or in rows of up to 23 along a stem. The rows were not continuous but had gaps separating them into groups of 3 or 4 and single eggs. The second locality was a shallow pond which varied from one to two feet in depth. Here the eggs were also in rows along plant stems, one group of five eggs and another of two. These were well advanced with the embryos occasionally twitching.

Scaphiopus bombifrons, PLAINS SPADEFOOT

Logier and Toner (1961) presented a map of the known distribution of this species in Saskatchewan in which the range limit was delimited by Alsask, Elbow, Bengough and Roche Percée. Three new collections partially fill the gap between the second and third localities. Single specimens were taken along Highway 1 east of Moose Jaw after a heavy rain the night of May 21-22, 1961: 1.5 miles east of Uren (turnoff) (NMC 5273); 0.2 miles east of Mortlach (turnoff) (NMC 5274); 4.9 miles west of Caron (turnoff (NMC 5275) (Figure 1).

All Saskatchewan specimens obtained so far are well within the grassland region of Rowe (1959). However, in Manitoba the species has twice been found in grassland areas within the aspen parkland (Cook and Hatch, 1964) and on August 23, 1964, Dr. A. W. F. Banfield identified a DOR specimen seen on Highway 1, 4 miles west of the Saskatchewan-Manitoba border (*see* Figure 1) as this species (PC: A. W. F. Banfield, 23 October 1964). Additional populations will likely be discovered in southeastern Saskatchewan.

The first definite breeding date for the Spadefoot in Saskatchewan was obtained June 1, 1962, 10.6 miles northwest on Hwy. 39 of North Portal, when a chorus estimated to be in the hundreds was heard. Males were calling from partially flooded fields and ditches, and several pairs in amplexus were found. Spadefoots were heard almost continuously that evening between Roche Percée and North Portal. Interestingly, one or two Boreal Chorus Frogs, *Pseudacris triseriata maculata*, were the only other anurans heard among this otherwise exclusively *Scaphiopus* chorus. The following night large numbers of *Scaphiopus* were again calling in the same areas. An auditory survey north of Roche Percée on the two evenings revealed few localities for Spadefoots. Distant small choruses were head 4½ and 9 miles northwest of Roche Percée, 2 miles east of Estevan and 4½ miles northwest of Estevan. The reasons for this contrast in abundance of *S. bombifrons* north and south of Roche Percé are not certain. The Souris River flows through the town and the land south of it is at a slightly lower elevation. During this period, standing water was present nearly continuously along the roadside edges of fields from Roche Percée to North Portal in the area of intense Spadefoot calling. To the north there was less evidence of temporary ponds. Whether these contrasts were due to differential rainfall received just prior to the observation periods or due to actual differences in soil and drainage is unknown. If lesser amounts of rain were received north of Roche Percée, this would acount for the fewer *Scaphiopus* heard there. However, if the soils or drainage are different, there may be a real difference in the availability of breeding sites and the number of *Scaphiopus* produced.

Rana sylvatica, WOOD FROG

Logier and Toner (1961) cite only one record in the southern part of Saskatchewan for the Wood Frog, Indian Head. Collecting during the spring breeding period of this frog has revealed its approximate southern limit. These records form a northwest-southeast line from Macklin to North Portal, and are listed as follows (where specimens have been collected their catalogue number

is cited; other ceords are auditory): Macklin, May 9, 1962 (NMC 6001); 3.1 miles east of Evesham, May 10, 1962 (NMC 6002); 8.4 miles south on Hwy. 4 of Biggar, May 14, 1962; 12.6 miles south on Hwy. 4 of Biggar, May 14, 1962; Laura, April 30, 1961, May 8, 1961; 0.4 miles north on Hwy. 11 of Hanley, June 4, 1959 (NMC 3998); 1 mile south on Hwy. 11 of Hanley, June 4, 1959 (NMC 3999); 1.8 miles west and 15.2 miles north of Belle Plaine, May 18, 1961 (NMC 5262): 7.4 miles east of Briercrest, June 22, 1961 (NMC 5416); 2.5 miles east on Hwy. 39 of Rouleau, May 12, 1961 (NMC 5250); 4 miles north and 0.9 miles northwest on Hwy. 6 of Milestone, April 22, 1961 (NMC 5221), April 23, 1961 (NMC 5225); Weyburn, May 18, 1961; 2.2 miles west on Hwy. 39 of North Portal, May 13, 1961 (NMC 5254). These records are shown by nine symbols in Figure 1. There is an old collection (NMC 55) labeled "Moose Jaw", "June 20, 1896". The writer has searched for this species at Moose Jaw without success and it is possible that the specimen was actually taken some miles north within the presently known range and labeled as the nearest town, a common practice of the time.

The limiting factor for *Rana sylvatica* at the southern edge of its range in Saskatchewan is the presence of the prairie grassland. This frog is abundant in the aspen parkland and boreal forest to the north, but does not occur more than a few miles south of the last more or less continuous clumps of aspen woods. Its typical habitat at its southern limit is relatively small, usually temporary, depression ponds which are at least partly surrounded by bushes and often a few aspens. Occasionally they have been taken in ponds, dugouts or ditches which are not bordered by bushes or trees, but which do have very thick stands of cattail. It is likely that these Wood Frog collections represent temporary southern extensions of the range during favourable years. Wood Frogs have been heard calling from mid-April until mid-May near their southern limit, but the breeding period at any one locality probably is of shorter duration and population levels seem to be quite low.

The factors which exclude the species from the grassland are yet to be demonstrated. However, it is likely that the adults do not thrive in the dry prairie where temporary ponds and streams and rivers are the major sources of moisture. The creation of numerous farm dugout ponds does not seem to have facilitated its spread. The surrounding prairie offers little suitable habitat for this woodland species, especially in dry years. It seems probable that the southern limit fluctuates from year to year, populations advancing south during a series of wet years when there is thick vegetation and some moisture throughout the summer and fall at pond margins. These temporary advances would likely be exterminated during exceptionally dry years.

Chelydra s. serpentina, SNAPPING TURTLE

Criddle (1919) in commenting on the range of the Snapping Turtle in Manitoba added that he had "seen examples as far west as eastern Saskatchewan in the Souris River". This record was repeated by Mills (1948) and Logier and Toner (1955). The Saskatchewan Museum of Natural History has a specimen collected "1 mile southeast of Oxbow, Sect. 14, Tp. 3, R. 2, W. of 2nd Mer., April 18, 1933", and this was included in the latter authors' second edition of their checklist (1961). Priestly (1945b) commented that it "has been taken in the Souris River", and Carmichael (1949) noted that a 28 pound specimen was collected September 26 by Mr. E. R. Rodenbush at Glen Ewen.

The first indication that this species may occur outside the Souris River in eastern Saskatchewan was a report in the *Regina Leader-Post* (May 9, 1961) of a specimen found in the farm dugout of Otto Karius, 5 miles south of Melville. The shell of this specimen was later obtained by the Saskatchewan Museum of Natural History and presented to the National Museum of Canada where it is catalogued as NMC 5399. This locality is north of the Qu'Appelle River valley and may indicate that the species occurs in this drainage in Saskatchewan. However, the chance that it might have been an escape cannot be ruled out, and further specimens from the area are needed to substantiate the presence of a natural population.

Snapping Turtles have also been reported from southwestern Saskatchewan where the "Whitemud" [Frenchman] River enters Montana (PC: Nelson Gowan, September 3, 1959), but no specimens are available. These records are plotted in Figure 2. The Souris and Qu'Appelle river records represent migration from Manitoba, while the report from southwestern Saskatchewan indicates that this species may also migrate north through the Missouri River drainage.

Chrysemys picta belli, WESTERN PAINTED TURTLE

Logier and Toner (1961) list and map only three records of the Western Painted Turtle in Saskatchewan. A search of back issues of *The Blue Jay*, examination of collections at the Saskatchewan Museum of Natural History and University of Saskatchewan, and reports of local residents have provided enough additional data to form a fairly detailed outline of this species' range in the province. The known records may be divided into three areas, the first two in southeastern Saskatchewan, and the other in the southwestern portion of the province. These records are shown in Figure 2.

Area 1 (Qu'Appelle Valley): Cut Arm Creek where it enters the lower Qu'Appelle valley about nine miles southwest of Spy Hill (Kelley, 1960); Gerald (along railway track, and in Cutarm Creek), 16 miles north of the Qu'Appelle valley (Priestly 1945b); in a summerfallow field, ½ mile from York Lake, seen by Mr. Hogson (Shaw, 1947); Round Lake, August 30, 1954 (US, R-68), July 28, 1957 (US, R-83), one seen May 24, 1945 (Priestly 1945a), seen October 13 by Mr. Jack Willis (Shaw, 1947); Crooked Lake (PC: local fisherman); Indian Head (Kirchner, 1959); 45 miles northeast of Regina (PC: local resident July 6, 1959); between Lumsden and Craven, May 4, 1961 (PC: R. W. Nero); Valeport (PC: local resident); Regina, April 1915 (SMNH), (PC: R. W. Nero *in* Logier and Toner, 1961, p. 55) and April 15, 1961 (NMC 5248), April 22, 1961 (NMC 5249), Alan Wade; Pense, October 27, 1947 (SMNH).

Area 2 (Souris River): Refret Creek, tributary to Souris River, (Baker, 1959); Weyburn (Baker, 1959); 27 July 1959 (F. R. Cook); on road north of Yellow Grass, June 2, 1958 (PC: Brian Malley to SMNH).

In addition there is one specimen from Langbank, June 4, 1959 (NMC 4012) collected by R. H. Davis as it was crossing a road. According to Mr. Davis, there had never been a turtle found in this area previously. This specimen may have been a wanderer which had followed up streams flowing to the Souris River.

Area 3 (Southwestern Saskatchewan): The forks of Old Wives Creek (Macoun, 1896: 142); Wood Creek, 3½ miles northeast of Wood Mountain, July 22, 1929, C.M. Sternberg (NMC 1549[2]); pond southwest of Killdeer (PC: Bruce McCorquodale May 11, 1961); Notukeu Creek at Gouverneur Dam, 1 mile west of Gouverneur, one seen on July 11, 1958 (Bird, 1959); Notukeu Creek near Cadillac (Bird, 1959); approximately 10 miles south of Masefield (PC: Nelson Gowan); pond at Robsart; Battle Creek (PC: customs official at Willow Creek July 3, 1962).

There is a single report from the South Saskatchewan River. In a letter dated November 14, 1956, Mrs. Hugo Opahill recorded seeing a turtle swimming against the current and caught on the ferry approach at Leader Ferry on the South Saskatchewan River. As there are no other observations for this area this specimen must be suspect as an escape, and is omitted from the map, Figure 2.

The records from the Qu'Appelle and Souris rivers probably represent populations more or less continuous with those in Manitoba, where the species is more abundant. The few records near these rivers but outside their valleys represent either wanderers or escaped captives.

The presence of the painted turtle had gone unreported in western Saskatchewan until noted by Bird (1959). These populations seem scattered, and are probably more-or-less isolated from each other. Recently a similarly isolated population has been found in southeastern Alberta (Lewin, 1963a, 1963b).

Nelson Gowan, who contributed the record from 10 miles south of Masefield, supplied the following information on Painted Turtles in southwestern Saskatchewan (PC: 3 September 1959), "the turtles I have, locally gained entrance to this pond, I expect, by coming up the Milk River, entering a small tributary called Whitewater.

"By following Whitewater tributary they would have had to cross one mile by land. . . They grow here to nearly a foot in diameter, but small ones are most common in any of the warm waters to the southwest. They have inhabited this country for at least 85 years. I have seen them all the way from Wood Mountain, southwest to the Alberta border, but I don't know of them living more than 28 miles north of the U.S. border.

"They seem to thrive in sloughs, dug-outs and tributarys of the Frenchman River that do not freeze to the bottom in winter time. I have never known them to follow the springwater streams into the Cypress Hills or Wood Mountains."

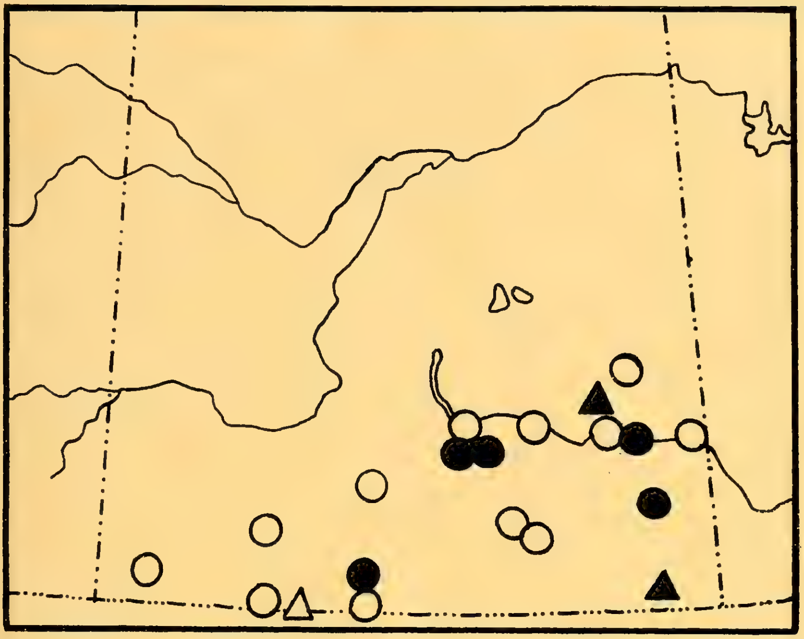

FIGURE 2. Outline map of southern Saskatchewan showing location of records given in the text for *Chelydra s. serpentina* (triangles) and *Chrysemys picta belli* (circles). Museum specimens are shown by solid symbols; reports and sight records by hollow symbols. In some cases a symbol marks the location of more than one record.

It seems probable that these individuals spread into the province from the Milk and Missouri river system separately from those which occur in eastern Saskatchewan, and on the basis of Mr. Gowan's comments and the large number of records there is little doubt that these collections represent naturally occurring populations rather than escapes or deliberate introductions.

Thamnophis elegans vagrans, WANDERING GARTER SNAKE

Logier and Toner (1961) give four localities for this garter snake in Saskatchewan: "Gouldtown (PC: R. W. Nero). Herbert (ROM). Saskatchewan River Valley north of Stewart Valley (PC: R. W. Nero). Twelve Mile Lake (Sternberg, 1930, p. 149)".

Four specimens presented to the National Museum of Canada by Dr. R. C. Connell of the Veterinary Laboratory, University of Saskatchewan, are the first representatives of this species taken north of the South Saskatchewan River in the province, although it is known to occur farthur north in Alberta (Logier and Toner 1955: 58; 1961: 65). These specimens were collected 23 miles north of the river, approximately 6¼ miles south and two miles east of Beadle on July 6, 1962 (NMC 6353[2]) and April 25, 1963 (NMC 7369[2]).

Dr. Connell also reported (PC: August 23, 1963) observing *T.e. vagrans* at Brightsand Lake, about 145 miles north of the Beadle collection. Although as yet unsubstantiated by specimens this is the northernmost record for the province. The eastern record for the species in Saskatchewan, Twelve Mile Lake (Sternberg, 1930), is also unsubstantiated by specimens.

This species is apparently much rarer on the prairies than the very successful Western Plains Garter Snake, *Thamnophis radix haydeni*, although it may occur more continuously over the southwest corner of the province than the Red-sided Garter Snake *Thamnophis sirtalis parietalis*, whose distribution is apparently relict in this area. The distribution and variation of the latter species will be discussed in detail in a subsequent paper.

Crotalus v. viridis, PRAIRIE RATTLESNAKE

The range of the Prairie Rattlesnake in Saskatchewan is composed of two segments. The northern part is the result of the spread of the species east along the South Saskatchewan River from Alberta. It is abundant in Alberta between Medicine Hat and Empress. Deck (1951, 1956) commented on rattlesnake abundance in that area but apparently did not take any specimens in Saskatchewan. Logier and Toner (1955: 75; 1961: 78) cite reports communicated by L. M. Klauber from Estuary, fork of Red Deer and Saskatchewan Rivers, South Saskatchewan River north of Prelate and south of Metador (= Matador). Dr. Klauber's records were based on a postal-card questionnaire and correspondence with Saskatchewan observers mostly during the years 1935-1938. They are to be considered inexact to the extent that they are cited as the nearest named town or geographical place with a name (PC: L. C. Klauber, 9 March 1964).

Through the efforts of Mr. F. W. Kowatch of Estuary, the writer and C. B. Powell located a den approximately 3 miles east of Estuary and collected two specimens, May 22, 1962, and eight more May 24, 1962. This area is in the cutbanks on the south side of the river, and is marked by numerous holes caused at least partly by natural cave-ins in the underlying soils. Other dens were reported one and one-half miles west of the railroad bridge over the South Saskatchewan River east of Estuary, and on the north side of the river approximately opposite the one we visited. At the Westerham elevators, approximately three miles east of the den where we collected, rattlesnakes are regularly seen in the summer between about July 10 and August 15. The period of observations seems to indicate that the individuals seen may come from the den 3 miles east of Estuary rather than a closer, undiscovered den. The most eastern report obtained was at Prelate Ferry, about 17½ miles east of Estuary. Here rattlesnakes are very rarely seen, and perhaps the occasional one that is observed has drifted down river from the Estuary-Westerham area on debris and has been washed ashore. The Matador record listed on the authority of Klauber by Logier and Toner (1955, 1961) may represent similar straying as there seem to be no additional reports east of Prelate.

The second part of the Prairie Rattlesnake range in Saskatchewan is along the southern border of the province. Logier and Toner (1955, 1961) listed Bellanger Creek, Cypress Hills, Eastend, Govenlock, Rosefield and extreme southwestern Saskatchewan in Township 1, Range 30. These records were also based on communications from Klauber. The National Museum has a rattle (NMC 1524) collected at Govenlock in 1929 by D. A. Fleming. During field studies I have had additional reports from the Masefield and Rosefield areas from local residents. The eastern record for the province is a specimen (NMC 6886) collected July 5, 1962 by Clive Elliot, about 8 miles west of Killdeer and 2 miles north of the International Boundary. It measured about 48" long when it was killed. Bruce McCorquodale has reported on the authority of a reliable local resident that there is probably a den just south of the International border in this area.

The range of the Prairie Rattlesnake appears to be more or less continuous in southern Saskatchewan from the Alberta border to 8 miles west of Killdeer. They probably find suitable hibernating dens along the sides of coulees and river valleys in this area. The most northerly penetration reported in this area is about 35 miles from the border at or near Eastend. They apparently do not range into, or north of, the Cypress Hills as no reports could be obtained during field studies in this area in 1961. The "Cypress Hills" record based on a communication to Klauber was probably from south of the hills. It seems apparent that there is a hiatus between the populations in southern Saskatchewan and those farther north along the South Saskatchewan River, although the range is continuous to the west through populations in Alberta.

It is the writer's impression that rattlesnakes are less common where they do occur in Saskatchewan than in most areas of their Alberta range. The limiting factor for rattlesnakes on the northern prairies may be the availability of suitable sites for communal hibernation. In Saskatchewan and Alberta the known dens are along the cut-bank slopes of the river valleys. The lack of suitable hibernation areas between the South Saskatchewan and Frenchman rivers probably accounts for the obvious hiatus in their range in this area. Studies are needed on the distance rattlesnakes will spread in the summer from their wintering dens and the factors involved in the suitability of these dens.

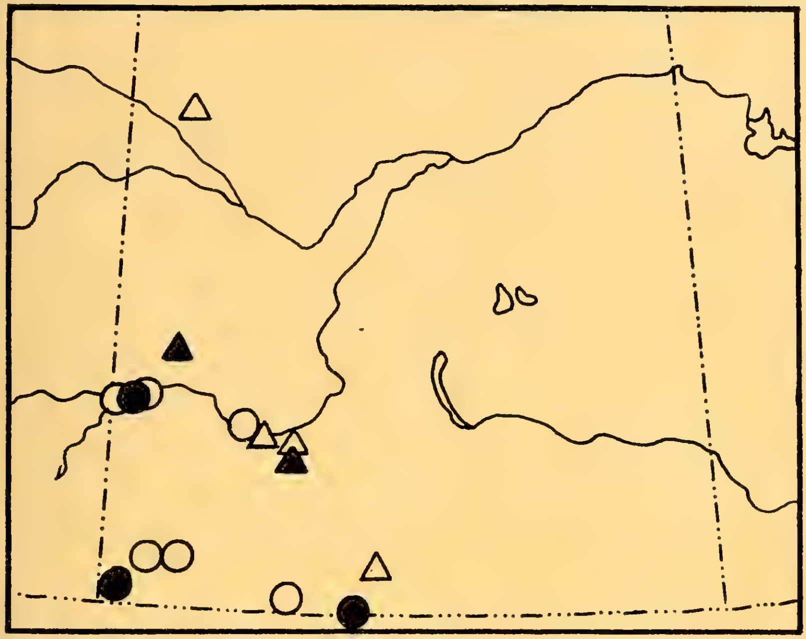

FIGURE 3. Outline map of southern Saskatchewan showing location of records given in the text for *Thamnophis elegans vagrans* (triangles) and *Crotalis v. viridis* (circles). Museum specimens are shown by solid symbols; reports and sight records by hollow symbols.

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REPORTS OF MARINE TURTLES FROM NEW ENGLAND AND EASTERN CANADA

J. SHERMAN BLEAKNEY
Biology Department, Acadia University, Wolfville, Nova Scotia

INTRODUCTION

MARINE TURTLES are considered to be tropical or subtropical and their occurrence in northern waters is typically dismissed as accidental. The standard reference books of Carr (1952), Conant (1958), and the more recent *Introduction to Herpetology* by Goin and Goin (1962) leave one with the impression of tropical marine turtles being just that. However, recent personal observations and a search of the literature revealed 112 documented coastal records of marine turtles from Newfoundland to Connecticut (Table 1) with an indication of a seasonal occurrence. A reappraisal of the status of these turtles in the cold waters of Eastern Canada and New England is presented here.

TABLE 1. — Summary of records of marine turtles reported from the coastal waters of New England and Eastern Canada. Compiled from the literature, newspaper reports, correspondence and personal observation, 1824–1964.

	Conn.	R.I.	Mass.	N.H.	Maine	N.B.	N.S.	Nfld.	Totals
Dermochelys	4	5	16	1	33	2	25	2	88
Lepidochelys	–	–	7	–	1	–	4	1	13
Caretta	1	–	1	–	1	–	2	1	6
Eretmochelys	–	–	1	–	–	–	–	–	1
Chelonia	1	–	2	–	–	–	–	–	3
	6	5	27	1	35	2	31	4	112

REPORTS OF MARINE TURTLES

The occurrence of marine turtles of tropical origin along the coast of New England, Nova Scotia and even Newfoundland is an annual event. Fishermen interviewed at all major fishing ports in Nova Scotia spoke of "the turtle season" as extending from June to October. In June, sea turtles are commonly seen off the Georges Bank along the edge of the Gulf Stream and apparently move inshore throughout the summer months. One specimen of the Atlantic Leatherback, *Dermochelys coriacea coriacea*, taken off Halifax, September 7, 1964, had a twig embedded in the floor of its left orbit. W. L. Stern, United States National Museum, identified this plant material as *Avicennia sp.*, a black mangrove, which occurs no farther north than southern Florida. In late September of 1964, two Leatherbacks were captured off the coast of New Brunswick at Little Shemogue, in the Northumberland Strait. This is 450 sea miles from the Atlantic coast of Cape Breton Island, the nearest previous Leatherback report, and is the first record of a marine turtle from the Gulf of St. Lawrence. Small specimens of undetermined species of sea turtles are occasionally taken aboard ships along the Atlantic coast of Nova Scotia but are usually released. Rarely do the offshore fishermen attempt to capture larger specimens which they report are of both the hardshell and leatherback variety. Specimens most frequently landed are individuals entangled and drowned in fishing gear or harpooned by inshore fishermen. Occasionally these events are recorded in a daily newspaper but even less often in a scientific journal (Table 2). Of considerable significance is the fact that the majority of these scientific reports can be attributed to the interest of two men, H. L. Babcock in the Boston region, and Harry Piers of Halifax, Nova Scotia. Both were museum men and fine naturalists. When the 112 records were plotted on a map, they were concentrated near three centers; Boston, Halifax and Woods Hole, in that order of importance. Probably an interested naturalist at other ports in between these localities would have been equally successful. For example, Keiler Bentley, formerly of Halifax and presently Director of the Alexander Graham Bell Museum, Baddeck, Nova Scotia, kept records of all Nova Scotia amphibians and reptiles but never published the data. He recently made this information available to F. R. Cook, Curator of Herpetology, National Museum of Canada, Ottawa. In it are eight additional reports of Leatherbacks

TABLE 2. — Records of Leatherback sea turtles from Eastern Canada, including a few published previously but not generally familiar to herpetologists.

Date	Source of Information	Locality	Remarks
1889, Aug.	Proc. N.S. Inst. Sci. VII, p. 467.	Prospect, Hfx. Co. N.S.	caught in net.
1894, 9, Sept.	Proc. N.S. Inst. Sci. VIII, p. 395	Hubbards Cove, Hfx. Co. N.S.	entangled in net, lived four days.
1895, 16, Aug.	Proc. N.S. Inst. Sci. IX p. 225	Hubbards Cove, Hfx. Co. N.S.	kept alive at least 34 days.
1897, August.	private files of K. Bentley (see text).	Prospect, Hfx. Co. N.S.	entangled in net.
1909, 23, Aug.	Bentley files.	Shad Bay, Hfx. Co. N.S.	"said to weigh 1,000 pounds".
1913, summer.	Bentley files.	Portuguese Cove, Hfx. Co. N.S.	captured and later liberated.
1915, 5 Sept.	Bentley files.	Pennant, Hfx. Co. N.S.	on display at Prov. Exposition, Hfx.
1928, 25 Oct.	Bentley files.	Coast of Nova Scotia.	taken by National Fisheries Co.
1934, 10 July.	Ann. Rept. Prov. Mus. & Sci. Lib., 1934.	Eastern Passage, Hfx. Co. N.S.	entangled in net.
1934, 2 Sept.	Ann. Rept. Prov. Mus. & Sci. Lib., 1934.	Hubbards, Hfx. Co. N.S.	—
1940, about.	Bentley files,	St. Peters Canal, Richmond Co.	identified from photographs.
1946, 9 Aug.	Bentley files.	Northwest Cove, Hfx. Co. N.S.	—
1955, early Aug.	Halifax Chronicle-Herald, 24 Aug. 1955.	off Cape Breton Island.	"weight 1,400 pounds".
1955, 21 Aug.	Halifax Chronicle-Herald, 24 Aug. 1955.	Sambro, Halifax Co. N.S.	frozen in 1955; dissected in 1964.
1961, 21 Aug.	Halifax Chronicle-Herald, 22 Aug. 1961.	West Dover, Halifax Co. N.S.	harpooned.
1961, 11 Sept.	Examined by author.	Terence Bay, Hfx. Co., N.S.	entangled in net and drowned.
1962, 14 Sept.	Examined by author.	Lower Prospect, Hfx. Co., N.S.	entangled in net and drowned.
1963, 6 July.	Halifax Chronicle-Herald, 9 July, 1963.	Halls Harbour, Kings Co. N.S.	died after two days tied to wharf.
1963, 13 Aug.	Examined by author.	Prospect, Hfx. Co. N.S.	hooked on Norwegian jig.
1964, 17 July.	Examined by author.	Terence Bay, Hfx. Co. N.S.	harpooned; cast in fibreglass.
1964, 25 Aug.	Identified through photo & interviews.	Tangier, Hfx. Co. N.S.	hooked on Norwegian jig.
1964, 7 Sept.	Halifax Chronicle-Herald, 8 Sept., 1964.	Prospect, Hfx. Co. N.S.	drowned in fishing gear.
1964, Sept.	From interview by author.	Summerville, Queens Co. N.S.	drowned in fishing gear.
1964, 22 Sept.	The Moncton Transcript, 23 Sept., 1964.	Little Shemogue, Westmorland County, New Brunswick.	drowned in fishing gear.
1964, 29 Sept.	Newspapers and correspondence.	Conception Bay, Newfoundland.	harpooned; put on display.
1964, 2 Oct.	Correspondence with W. A. Squires.	Cape Bauld, Westmorland County, New Brunswick.	taken alive.

TABLE 3. — Dimensions in inches of *Dermochelys coriacea coriacea* from Halifax County, Nova Scotia. Except for the first three specimens, measurements were straight line unless indicated "C" for those taken along curve of the shell.

Date	Sex	Total Length	Carapace		Pound Weight
			Length	Width	
Aug. 1889	—	60.0	42.5	—	250
Sept. 9, 1894	—	86.0	58.0	34.0	785
Aug. 16, 1895	—	75.0	58.0	—	—
Aug. 21, 1955	m	79.5	58.0	30.0	670
Sept. 11, 1961	m	94.0	65.5 C	44.0 C	900
Sept. 14, 1962	f	86.0	71.0 C	45.0 C	—
Aug. 13, 1963	m	91.0	59.5	46.5 C	—
July 17, 1964	f	73.5	60.0	—	—
Sept. 7, 1964	m	93.5	64.5	—	—

from Nova Scotia. Similarly, the newspaper clipping file of the late A. H. Norton, former curator of the Portland Society of Natural History, published in 1960 by Scattergood and Packard, added 12 new *Dermochelys* reports to the coast of Maine. My own interest in reports of marine turtles began in 1961 and in four seasons I have recorded eleven specimens, six of which were dissected. The Atlantic Leatherback is the most commonly reported perhaps because of its large size and unique appearance. However, other species have been reported by local fisheries officers and include *Lepidochelys olivacea kempi*, the Atlantic Ridley; *Caretta caretta caretta*, the Atlantic Loggerhead; *Chelonia mydas mydas*, the Atlantic Green Turtle; and *Eretmochelys imbricata imbricata*, the Atlantic Hawksbill. The latter two have not been substantiated by actual specimens.

The best reports were those of Piers, published from 1889 to 1934, for he recorded the method of capture and made detailed measurements when possible. Generally, neither size, sex nor weight were accurately recorded by other observers, and only 70 of the 112 reports included the month of capture. Overall measurements are presented for nine Nova Scotia Leatherback specimens in Table 3, and more detailed data on outline diagrams is available upon request.

BEHAVIOR IN NORTHERN WATERS

The marine turtles which visit the coastal waters of the Gulf of Maine and the Atlantic coast of Nova Scotia and Newfoundland appear not to be benumbed by the cool sea temperatures (55°F to 65°F), contrary to the views expressed by Babcock (1939), Squires (1954), Conant (1958) and others. If the latter were true, reports of stranded turtles should be as common as offshore turtle sightings. In the northeast Atlantic the warmer North Atlantic Drift Current is probably the factor which enables these tropical turtles to reach 61°N latitude off Scotland and Norway. Eight recent records of *Dermochelys* off Norway (Willgoh, 1956, 1957, 1958 and personal communication with that author) indicate animals in vigorous health. Of fifteen records from Scotland

(Stephen, 1953) only two were found dead. Table 4 shows the frequency of occurrence of turtles in our area in relation to time of year, based on reports from 1840 to 1964. It is evident that July to October is the period when the turtles move inshore. Only three dead specimens have been reported from this area: one Loggerhead from 100 fathoms depth on January 6, 1953, off the Grand Bank of Newfoundland (Squires, 1954) and being slightly decomposed this specimen could have drifted from much farther south; a Ridley washed ashore south of Martha's Vineyard in March of 1903 (Barbour, 1942); and another Ridley found dead at Margaretsville, (Bay of Fundy), Nova Scotia, on October 14, 1928. Of course, there is no evidence that these three turtles did not die of natural causes other than cold water. The waters off the Atlantic coast of Nova Scotia are near 63°F during August and September (Table 2) yet these tropical reptiles are reported as very active and difficult to subdue. Piers (1896) recounts how on two occasions Leatherbacks captured off Halifax were taken to the city and put in tanks at the waterfront. One of these turtles was kept alive from August 16 to September 20. 1894, on which date Piers tried to measure it, but it was so active he admits his figures are not precise. Unfortunately, the subsequent fate of this specimen was not recorded.

During the 1964 season live Leatherbacks were reported tethered to wharves at three localities in Nova Scotia. All three turtles strained at their rope harnesses with alternating periods of swimming and resting.

Moulton (1963) reported the recapture of a marked *Dermochelys* in Casco Bay, Maine, and believes that during August several of these turtles were in the same vicinity for approximately two weeks. Supporting evidence for normal activity of leatherback turtles in northern waters comes from British Columbia where MacAskie and Forrester (1962) reported a very active *Dermochelys* at 53°F water temperature near the Queen Charlotte Islands on September 23, 1961. Cloacal temperatures of marine turtles taken by Hirth (1962) in Costa Rica were only slightly above the local sea temperature of 82°F. Whether this holds true in Nova Scotia waters is as yet unknown.

Evidently there is an annual invasion of our cool Atlantic coastal waters by turtles of tropical origin. In the light of our present knowledge of the navigational and migratory abilities of vertebrates, including marine turtles, this writer concludes that these northward travels are made by healthy turtles of various ages and both sexes capable of navigating the North Atlantic and quite able to leave the Gulf Stream, penetrate the Labrador Current, and navigate away again by late September. Do some individuals then turn southward to nesting sites in the Caribbean while others follow the Gulf Stream towards Europe?

FEEDING HABITS OF LEATHERBACKS

The fact that healthy marine turtles would move inshore to coastal New England and Canada during August and September should be associated with feeding habits, yet only two specimens from New England (Sears, 1866; Ray and Coates, 1958) and five Nova Scotia specimens reported here, have ever been examined for stomach contents. Ray and Coates reported only a small piece of *Fucus* weed in their *Dermochelys*. Five *Dermochelys* recently examined

TABLE 4. — Monthly distribution of reports of marine turtles along the coast from Connecticut to Newfoundland, 1840–1964. Each (D) represents one specimen found dead. Mean monthly sea surface temperatures are given from June to October (U.S. Navy Oceanographic Office, Washington, D.C.).

Species	Reports	Jan.	Mar.	June	July	Aug.	Sept.	Oct.
Dermochelys	54	—	—	—	9	29	15	1
Lepidochelys	8	—	1(D)	—	1	3	—	3(D)
Caretta	4	1(D)	—	1	—	2	—	—
Chelonia	3	—	—	—	—	—	2	1
Unidentified	1	—	—	—	—	1	—	—
Totals	70	1	1	1	10	35	17	5
Surface temperatures off Nova Scotia:				48 F	55 F	63 F	63 F	59 F
Surface temperatures off Georges Bank:				53 F	58 F	63 F	64 F	60 F

by the author at Halifax all contained pieces of the body and tentacles of the large northern jellyfish *Cyanea capillata arctica.* In addition, specimens of the amphipod crustacean, *Hyperia medusarum*, a parasite associated with *Cyanea* were found in four stomachs. It seems improbable that a diet of jellyfish could sustain turtles weighing nearly one half ton, but the anatomy of the digestive tract and a critical analysis of the meager literature on food habits of *Dermochelys* indicates such is the case. The anatomy of the specimens dissected agreed with the excellent anatomical descriptions of Burne, (1905). Two to three inch long backward projecting spines line the mouth cavity and cover the surface of the J-shaped esophagus for its entire length, which was 6 feet 4½ inches long in the 1962 specimen (Table 2). Such a specialized modification of the anterior parts of the digestive tract reflects a diet of slippery prey but certainly not fish. The backward projecting spines in the mouth are too flexible at their bases and too long to restrain active fish. Numerous short conical teeth or tooth-like structures have been evolved for that function by other vertebrates. The rigidity of vertebrate prey in general makes esophageal spines superfluous, for the peristaltic movements act against the firm prey very effectively. The presence of spines, of various sizes and from buccal cavity to stomach, indicates an extremely soft slippery prey such as pelagic Scyphomedusae, Hydromedusae and Ascidiacea. Perhaps herpetologists have been reluctant to believe that *Dermochelys* subsists on jellyfish (although an equally large fish, *Mola mola*, is known to do so) and have therefore overlooked the gelatinous mucoid-like contents of the digestive tract. In addition, the original reports of stomach contents have been misconstrued to such a degree that in the recent text by Goin and Goin (1962) the diet of *Dermochelys* is stated as being crustacea, mollusca, small fish as well as marine plants. There is no mention of jellyfish. Each one of these food categories deserves critical comment.

Crustacea: The only specific crustacean reports noted in a search of the literature were Sears (1866) who found amphipod crustaceans in a Massachusetts specimen but thought they might become ingested when attached to a jellyfish;

Vaillant (1896) who identified *Hyperia galba*, a parasitic amphipod associated with the jellyfish *Aurelia;* and Willgohs (1956) who reported many *Hyperia* from a Norway Leatherback. Including the *Hyperia medusum* found in four Nova Scotia specimens, it can be said that the only identified crustacean remains from *Dermochelys* are two species of small amphipods normally associated with pelagic jellyfish.

Mollusca: Burne (1905) quotes Tickell as saying Audubon believed molluscs, fish, crustacea, sea urchins and marine plants to be the basic food of *Dermochelys*. No other reference to molluscs was noted. The oral apparatus of the Leatherback is certainly not anatomically similar to that of typical shell crushers.

Fish: The specimen Burne dissected in England came from Japan and had a small teleostean fish in the mouth. This could well have been consumed inadvertently with jellyfish, for Mansueti (1963) has shown that in all oceans the juveniles of many teleosts associate very closely with jellyfish. Burne's report appears to be the only mention of vertebrate remains from the digestive tract of *Dermochelys* and at that the fish was only in the mouth. However, a partially digested fish, along with pieces of *Cyanea* and seven *Hyperia medusum*, were found in the stomach of a Leatherback captured near Halifax in 1955 (Table 1). This turtle remained in cold storage until its dissection on August 18, 1964. The fish remains were identified by S. H. Weitzman, of the United States National Museum, as a young cod of the genus *Urophycis*. This fish, according to Mansueti (1963, p. 53) has twice been reported in symbiotic association with *Cyanea capillata* off the coast of New England.

Marine Plants: It is to be expected that traces of marine plants would be found within *Dermochelys* for if it feeds on pelagic organisms, drifting fragments of sea weeds would occasionally be consumed. Reports of marine plants include 20 grams of plant debris (Vaillant, 1896); a small piece of seaweed (Burne, 1905); fine blue-green algae (Deraniyagala, 1930); and a piece of *Fucus* (Ray and Coates, 1958).

Pelagic Jellyfish and Tunicates: Of great interest relative to the anatomy of the digestive tract of the jellyfish found in the five Nova Scotia specimens are reports of jellyfish (Sears, 1866); fragments of medusae (Vaillant, 1896); simple and compound tunicates (Burne, 1905); and Scyphomedusae (Deraniyagala, 1930). On December 17, 1956, Leary (1957) observed about 100 *Dermochelys* in dense schools of the jellyfish *Stomolophus meleagris* off a deserted beach on the Texas coast. He noted that "the turtles were most numerous where these jellyfish were most dense", but inferred nothing from this believing that the turtles were congregating for nesting purposes. Carr (1959) supports Lary's interpretation in spite of the fact that the general nesting season for marine turtles is May to August, not December. Certainly, from the available evidence, one can conclude that the diet of one of our largest reptiles consists chiefly of jellyfish and their parasites and symbionts.

TOXICITY OF LEATHERBACK TISSUES

Perhaps the accumulation of toxins from scyphozoans and hydrozoans accounts for the sporadic cases of food poisoning known from this species in the Pacific region. Wangersky and Lane (1960) have shown that the toxins of *Physalia* retain their full virulence when suspended in Loggerhead blood. However, portions of the pectoral muscles of three Leatherbacks landed at Halifax were eaten by a number of persons who suffered no ill effects.

If toxic substances do accumulate in the integument of Leatherbacks, this might account for the fact that plants or animals rarely become established on this turtle as epiphytes or epizoans. Both marine algae and barnacles are commonly found on the hard-shelled marine turtles. Because of this apparent ability to repel fouling organisms, the integumentary oil of one Leatherback was examined for antibiotic properties. Analysis of this oil was carried out by the Biology and Chemistry Departments of Acadia University and definite antibiotic effects were demonstrated (Wai-Ming Cheung, Thesis, Acadia University, Wolfville, Nova Scotia, 1963, unpublished). Additional analysis was undertaken by Dr. R. G. Ackman, Fisheries Research Board of Canada, Halifax, Nova Scotia, and an array of chemical compounds, unusual for a marine animal, were identified (Ackman and Burgher, 1955). Whether any of these substances actually do repel the epibionts has yet to be demonstrated.

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OBSERVATIONS OF A RUFFED GROUSE DECLINE

A. BRIAN RANSOM
Manitoba Wildlife Branch, 908 Norquay Building, Winnipeg 1, Manitoba

THIS PAPER PRESENTS SOME OBSERVATIONS made prior to, during, and following a decline of Ruffed Grouse (*Bonasa umbellus*) in the Turtle Mountain area of Manitoba. The information herein is fragmentary but is of value in light of Keith (1963) having pointed out the lack of factual information concerning Ruffed Grouse population fluctuations.

Turtle Mountain lies astride the International Boundary at approximately 100° longitude. It is an area of broadleaf forest and is one of Manitoba's best tracts of Ruffed Grouse habitat. A drumming transect, as described by Dor-

ney et al. (1958), has been run in the area since 1959 although comparative counts are available for only six listening stations. Wing collections were made during autumn in 1961 and 1962 and age ratios were determined using methods of ageing described by Hale, Wendt, and Halazon (1954).

Grouse were abundant in autumn from 1958 to 1961 and the spring counts of drumming grouse averaged 5.5, 12.8, 4.8 and 4.5 per listening station for the years 1959 to 1962, indicating that there were large breeding populations carried over each year. Grouse were extremely abundant during the autumn of 1962, and on the basis of subjective judgments they were probably more numerous than during any of the previous four autumns. Following the close of the hunting season in November, I drove through the area several times on trails that had been hunted and noted that grouse were still plentiful, indicating that a large population of grouse was once again being carried over. However, while travelling similar routes during January, I did not see a single Ruffed Grouse. Towards the end of February, Mr. J. E. Harrison, a conservation officer resident in Turtle Mountain, told me that he had recently noticed the almost complete absence of grouse. Mr. Harrison also stated that men employed at thinning a conifer plantation had found two dead grouse following a warm spell during the first week of February. Further evidence of a severe decline was obtained in May when the average number of drummings per station was 0.5. The completeness of the decline was clear in the autumn of 1963 when grouse were very rarely seen.

A sample of 267 Ruffed Grouse wings taken from Turtle Mountain and surrounding area in the autumn of 1962 had a juvenile to adult ratio of 1.4:1 compared to a ratio of 3:1 for 238 grouse taken in 1961. Similarily, 414 grouse from the North Dakota portion of Turtle Mountain had a 1.5:1 ratio in 1962 while 215 had 2.5:1 ratio in 1961 (Johnson 1963). While these age ratios indicate poorer production in 1962 than in 1961, I cannot over-emphasize the abundance of birds present at least to the end of November, 1962. This large population of grouse was decimated sometime during the winter, probably before the beginning of February. Since juvenile birds must have died during this period as well as adults, the decline cannot have been due wholly to reproductive failure, despite low juvenile to adult ratios.

It may also be significant that the highest spring population of grouse probably occurred in 1960 rather than in 1962. The phenomenally high count in 1960 may have resulted partially from particularly favourable conditions of weather, phenology and stage of breeding, but it is strong indication that the decline suffered in 1962-63 did not immediately follow a peak spring population.

The biological significance of two dead grouse being found in Turtle Mountain is unclear. However, Rowan (1948) states that during grouse die-offs "the birds leave practically no trace of death behind them: they just disappear, their skeletons rarely found in evidence" which indicates such finds are uncommon. The find at least shows the fallacy of interpreting Rowan's statement to mean that no dead Ruffed Grouse are found during die-offs, as Lack (1954) has done.

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SNOWSHOE HARE (*Lepus americanus struthopus*) HARVESTS ON LONG ISLAND, NOVA SCOTIA

DONALD G. DODDS and HARTFORD G. THURBER
Acadia University, Wolfville, Nova Scotia
and Department of Lands and Forests, Kentville, Nova Scotia

THE RECENT REVIEW OF wildlife's ten-year cycle (Keith, 1963) indicates that continued study and assessment of animals exhibiting this cycle are of value. This paper reports on the hare harvests for a 14 year period, 1950-1964, on an ecologically isolated unit of hare range in Nova Scotia. H. G. Thurber resided on long Island throughout much of the period and maintained the records used in the paper. Data were obtained from all resident rabbit hunters and snarers. Few non-resident hunters ever visit the Island. Beginning in 1960-61 information forms were distributed to all resident hunters prior to the opening of the season.

We wish to thank Dr. O. H. Hewitt for critically reviewing the manuscript.

DESCRIPTION OF THE AREA

Long Island is separated from a mainland peninsula known as Digby Neck by the Petite Passage which is approximately a quarter-mile across at its narrowest point. Strong tides prevail in the passage. The Island is situated in the most westerly part of Nova Scotia at a latitude of 44° 15′. It is approximately 11 miles long with a width varying to a maximum of one and one-half miles and a total area of 16.2 square miles. With the exception of two villages, a single road and scattered open fields, the entire Island can be considered suitable habitat for hares. This suitable habitat encompasses approximately 12 square miles.

The dominant forest type is a softwood complex of black spruce (*Picea mariana*), white spruce (*Picea glauca*) and balsam fir (*Abies balsamea*) with some larch (*Larix laricina*) in bog areas. Hemlock (*Tsuga canadensis*) and

white pine (*Pinus Strobus*) occur infrequently. A number of hardwoods grow about field edges and are scattered throughout the softwood forests. The most commonly occurring species are red maple (*Acer rubrum*), yellow birch (*Betula lutea*) and white birch (*Betula papyrifera*). Wire birch (*Betula populifolia*) and pin cherry (*Prunus pensylvancia*) are present as pioneer species in cutovers. Striped maple (*Acer pensylvanicum*), American mountain ash (*Sorbus americana*), and trembling aspen (*Populus tremuloides*) are less common.

Beds of speckled alder (*Alnus rugosa*) are present in areas of poor drainage and numerous other shrub and small tree species grow profusely over much of the Island. Among the more common are downy alder (*Alnus crispa*), dwarf willow (*Salix* spp.), hazelnut (*Corylus cornuta*), withe-rod (*Viburnam cassinoides*), blueberries (*Vaccinium* spp.), Labrador tea (*Ledum groenlandicum*), rhodora (*Rhododendron canadense*) and sweet gale (*Myrica gale*).

Forest and shrub growth is so thick that woods travel is difficult except in a few scattered areas of old growth.

Although no data are available relative to numbers, grouse (*Bonasa umbellus*) are common. The nature of the forest growth largely precludes heavy sport hunting pressure, however, a few are killed each year. Perhaps more are taken in rabbit snares than are shot.

Deer numbers have been high at least since 1950 and for the past four years more than five per square mile have been killed each season. Again, the dense forest growth makes hunting difficult and a large number of deer reported as legally killed are actually shot at night in the open fields along the highway.

Both Wilson's Snipe (*Capella gallinago delicata*) and Woodcock (*Philohela minor*) are numerous in the fall and are hunted occasionally by a few residents.

HISTORY PRIOR TO 1950

Snowshoe hares are native to Nova Scotia and older residents of Long Island confirm the presence of hares there prior to 1900. Hunting with dogs (beagle hounds) began about 1935 and has gradually increased until the present. Prior to 1935 most hares were taken by snaring although a few were taken by hunting without dogs.

Residents who have hunted hares since 1937 suggest that an "average" or "medium" population existed in 1937-38, "high" to "very high" numbers were present 1938-40 with "average" or "medium" numbers again occurring 1940-1947, "low" numbers between 1947 and 1948 and "average" numbers in 1949-50.

HARVEST RECORDS 1950-1964

The harvest of hares ranged from a low of 600, or 50 per square mile in 1956-57, to 2318, or 193 per square mile in 1960-61. Highest numbers were recorded in 1951-52 and 1960-61 (Table 1). The previous highest take before 1951-52 was probably the year 1939-40.

During the two years of heaviest harvests, 1951-52 and 1960-61, the ratio of hares shot to hares snared favoured shooting by less than two to one. However, the year of lowest total kill provided a ratio of 11.5 hares shot for

TABLE 1. — Hares harvested 1950–51 through 1963–64, Long Island, Nova Scotia.

Season	Number shot	Number snared	Total	Approximate kill per square mile of range
1950–51	1440	435	1875	156.3
1951–52	1264	836	2100	175.0
1952–53	1310	750	2060	171.7
1953–54	1065	405	1470	122.5
1954–55	676	380	1056	88.0
1955–56	532	158	690	57.5
1956–57	552	48	600	50.0
1957–58	680	175	855	71.3
1958–59	865	185	1050	87.5
1959–60	882	235	1117	93.1
1960–61	1526	792	2318	193.2
1961–62	1620	235	1855	154.6
1962–63	913	553	1466	122.2
1963–64	1091	390	1481	123.4
Totals	14,416	5,577	19,993	1,666.1 (119 per year)

every hare snared. These data suggest that hunting with dogs is a more effective means of harvest than snaring in this area.

Nova Scotia's snowshoe hare season opens November 16 and closes February 15; however, hounds are not allowed in the woods until after the close of the deer season, November 30. Few hares are shot until after December 1, although snaring does take place before that date.

Best success both per man day and dog day for the years 1960-64 occurred in 1960-61 while lowest success for this period was in 1962-63 (Table 2). Excluding the period November 16-30 when the use of hounds is illegal and excluding Sundays when hunting is not permitted there remain about 66 days for shooting each year. Between 1960 and 1964 there were between 4 and 5.7 dogs per day in the woods for the 66 days and between 11 and 14 men hunting per day. Lowest hunting pressure was in 1962-63 and highest pressure in 1961-62 over this four year period. No index of snaring pressure is available as the number of snares set and the periods in which snares were set were not available. Snaring pressure is restricted to areas in the vicinity of the farms, main road and villages, however, and is not exerted evenly throughout the wooded areas of the Island. Contrary to this, there are few if any areas not hunted with dogs and most are covered at least once a week.

MORTALITY

Predation is probably not a serious decimating factor on Long Island hares. The only two quadruped predators present which may kill hares are mink (*Mustela vison*) and ermine (*Mustela erminea*). Mink numbers are presently high and these animals are trapped by a few resident trappers. Weasels are not numerous. Hawks and owls frequent the Island and some predation may

TABLE 2. — Hares shot per man day and dog day, 1960–61 through 1963–64, Long Island, Nova Scotia.

Season	Number Shot	Number man days	Hares killed per man day	Number dog days	Hares killed per dog days
1960–61	1526	770	1.98	308	4.95
1961–62	1620	937	1.73	375	3.75
1962–63	913	742	1.23	270	3.38
1963–64	1091	825	1.32	300	3.64

occur from horned owls (*Bubo virginianus*) and red-tailed hawks (*Buteo jamaicensis*).

Dead hares are reported commonly during years of high density. In the spring of 1962 the authors investigated such reports and learned of several hares being run down by beagles during the latter part of the season. We also located two dead hares on an afternoon's search in February of that year. Hunters reported tape worm larvae present in hares in the years 1951, 52, 53, 60, 61, 63 and 64. I examined six hares from Long Island between 1960 and 1964 and found the larvae of *Taenia pisiformis* in all of them. It seems likely that at least some hares would be infested each year but hunters generally become aware of the parasites only during years of high infestation. Some mortality apparently occurs during years of high density, however, this mortality cannot be linked to any particular disease or parasite from our data.

Winters are less severe on Long Island than perhaps any mainland portion of Nova Scotia. Occasional snowfalls up to two feet are recorded but snows rarely last any great length of time. Rain and fog are common in the winter and spring; the spring and early summer are likely to be very wet. Extreme cold temperatures are uncommon. Although no weather records are available, mean low temperatures in winter would not be as severe as most mainland temperatures. Wet periods during parturition could be a contributing mortality factor, however, it does not seem likely that weather is important on Long Island in reducing peak populations.

SUMMARY

In the absence of any considerable natural predation and under relatively heavy harvesting the snowshoe hare population of Long Island, Nova Scotia has undergone a typical "10-year" fluctuation as depicted by total kill figures since 1950 and reports of populations prior to 1950. Peak kills occurred in 1939-40, 1951-52 and 1960-61 for an interval between peaks of 9-12 years. A low was reported in 1948-49 and was reflected in kill figures in 1956-57 for an interval of eight years between lows.

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THE AMPHIBIANS AND REPTILES OF LADY LAKE AREA, SASKATCHEWAN

Donald J. Buckle
Lady Lake, Saskatchewan

From 1961 to 1964 collections and life history notes were made of the amphibians and reptiles within a two mile radius of Lady Lake, Saskatchewan. A series of each species has been deposited in the National Museum of Canada. NMC catalog numbers are included in the species discussion, with the number of specimens for each given in brackets. Nomenclature follows Conant (1958).

I am indebted to Francis Cook of the National Museum of Canada for his help and encouragement and for the loan of data sheets pertaining to local specimens, and to Dr. A. H. Clarke of the same institution for identification of snails found in stomachs of *Ambystoma tigrinum.*

Lady Lake is located in east-central Saskatchewan about seventy miles north of Yorkton on No. 9 Highway. It is just within the southern edge of the boreal zone. Origionally the land was forested with meadows only on the most elevated portions. At present about three-fourths of the forest has been cleared for agricultural purposes. The substrata is gravel and clay till of typical knob and kettle formation. Because of this the land is rather poorly drained and sloughs are common in depressions. These sloughs provide abundant suitable habitat for amphibians. The Lilian River which flows past Lady Lake is a tributary of the Assiniboine River and part of the Hudson Bay watershed draining via the south end of Lake Winnipeg.

Ambystoma tigrinum, Tiger Salamander

Specimens: NMC 6312 (larvae), 6829(2), 7611(2), 7613(1).

The Tiger Salamander seems to be locally common but because of its secretive habits I have little information on it. It breeds in at least two dugouts and one small lake in the area. Adults have been found in shallow temporary pools in gravel pits, concealed under stones, and in cellars.

No observations were made of its breeding activity. Larvae were observed on July 10, August 5, and August 21 in 1962. The larvae may transform during the first half of September. Recently transformed adults were collected on September 19, 1962 and September 31, 1963. There is a possibility that some individuals may overwinter in the larval state.

Seven salamanders collected in an old flooded gravel pit were found to have fed almost exclusively on the snail *Stagnicola palustris* Müller which was common in the pool in the pit.

Fourteen adults were measured. The total length was 155 to 238 mm, average 189 mm, and body length 81 to 110 mm, average 98 mm.

Bufo hemiophrys, Canadian Toad

Specimens: NMC 6133(1), 6317(24 jv.).

The Canadian Toad is locally common. It seems to prefer wooded areas.

This species emerged later in the spring than the other anurans. It was first heard in mid-May (May 13, 1964) and its choruses continued until about the end of the month. No observations were made of its breeding activity but the young transformed in early July (July 5 and following in 1962). The young toads remained near the place of emergence for about two weeks, then gradually dispersed into the surrounding countryside.

Two adult specimens measured had body lengths of 48 and 52 mm.

Pseudacris triseriata maculata, BOREAL CHORUS FROG

Specimens: NMC 6134(9), 6316(17 jv.).

The Boreal Chorus Frog is abundant in this area at breeding pools in spring but because of its secretive habits it is rarely seen at other times. It prefers open and semi-open habitats and was occasionally found far from water. It was the most ubiquitous local frog, utilizing practically every available temporary and permanent water body for breeding purposes.

It was the first frog to appear in the spring. As soon as the first warm days and frost free nights arrived its "preep" was heard from shallow marshes and temporary sloughs filled by spring runoff. Later, as the water warmed, it was heard from deeper pools. Choruses began as early as the third week of April (May 1, April 23, April 13, and April 25, from 1961 to 1964 respectively) and continued until the end of June. No observations were made of its breeding activities. The young transformed during July, beginning on about July 5, 1961 and somewhat before July 5, 1962. In late summer individual frogs or small choruses were occasionally heard calling.

Eight adults were measured. The body lengths were 23 to 27 mm, average 24.8 mm and tibia lengths 8 to 10 mm, average 9 mm. The mean tibia/body ratio was 0.363. Seventeen juveniles collected on July 5, 1961 were 15 to 18 mm in body length.

Rana sylvatica, WOOD FROG

Specimens: NMC 6130 (186 jv.), 6131 (22), 6315 (19 jv.).

The Wood Frog is locally abundant. It has a preference for wooded areas and breeds in all permanent and semipermanent water bodies in suitable habitat.

Its choruses began shortly after those of *Pseudacris* (April 14, 1963; April 26, 1964). It is an "explosive breeder", most egg laying occurring in the space of about a week in any one location, as from April 25 to May 1, 1963 in a marsh along the Lilian River. During this peak period choruses begin at about noon and continue until morning. Frogs of this species show a tendency to lay their eggs close together. Groups of up to over a hundred egg clusters were found within areas of three or four square feet on several occasions. The number of eggs per cluster was found in fifteen samples taken in 1962 and 1963 to range from 536 to 1014 with an average of 762. In 1963 the eggs in the marsh referred to above took approximately fifteen days to hatch with a mean water temperature of 10°C. The young transformed from the last week of June on into July.

One hundred and ninety-eight specimens were measured. The body lengths were 30 to 51 mm, average 38 mm and tibia lengths 12.5 to 20 mm, average 17 mm. The mean tibia/body ratio was 0.447. Thirty-four percent had a light dorsal stripe.

Rana pipiens, LEOPARD FROG

Specimens: NMC 6132(16)

This species is locally abundant. It prefers open and semi-open habitats and was often found far from water, especially after rains. Breeding sites seem to be restricted to the larger, permanent water bodies.

The Leopard Frog was a later breeder than the two preceeding species. Choruses were first heard in the second week of May (May 10, 1963). Breeding activities were not observed. The young transformed in early August (August 4, 1961; before August 5, 1962).

Sixteen specimens were measured. The body lengths were 50 to 80 mm, average 61 mm, and tibia lengths 26.5 to 42.5 mm, average 32 mm. The mean tibia/body ratio was 0.524.

Thamnophis radix haydeni, WESTERN PLAINS GARTER SNAKE

Specimens: NMC 6136(8), 6137(4), 6138(1), 6139(1), 6313(1), 6314(1).

This species is locally abundant. It was found in all habitats in the area except coniferous forest and showed a preference for water margins.

It was first seen in the spring in late April. No matings were observed. Young were born in late July and early August. One gravid female was collected on July 21, 1962. Another, a captive specimen, gave birth to twenty-two young on July 28, 1961. Their average length was 169 mm and average weight 1.51 gm. Young snakes were commonly seen during early August.

In late September migration to hibernation sites takes place. I have never found a hibernaculum in this area but I have spoken to people who have seen several garter

snake heads peering out of ground squirrel holes in spring and autumn. It seems likely that most local snakes hibernate in small groups in rodent burrows as no reports have come to my attention of "snake hills" or large groups of snakes gathered together at one spot. Individual snakes were active until the middle of October.

The stomach contents of a small series were examined and found to contain frogs, tadpoles and minnows along with some invertebrate material.

Scale counts and measurements were made on seventeen specimens. Total lengths were 157 to 885 mm. Ventral scale counts of seven females were 154 to 165, average 160.7; of ten males 160 to 169, average 165.2. The number of subcaudals varied from 60 to 81. There were 7 to 10 lower labials, usually 8 or 9; and 7 to 8 upper labials, usually 7.

All of the species found in the Lady Lake area are wide ranging and abundant over a large part of the prairie provinces. Another common species in these provinces, the Red-sided Garter Snake (*Thamnophis sirtalis parietalis*), could reasonably be expected to occur at Lady Lake as this area is well within its range. However, out of over fifty garter snakes examined none were of this species. The Red-sided Garter Snake may be of sporadic occurrance over the southern part of its Canadian range and this may account for its absence here (PC: F. R. Cook). Another species that might possibly occur is the Gray Treefrog, *Hyla versicolor.* The westernmost records of this species are Camperville, Neepawa, and Killarney, Manitoba (Logier and Toner, 1961:36). As it was neither heard nor collected here it may not range this far west. However, further searching may yet reveal its presence in eastern Saskatchewan.

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NOTES ON FISHES FROM THE BROWNS FLAT AREA, KINGS COUNTY, NEW BRUNSWICK

STANLEY W. GORHAM
National Museum of Canada, Ottawa, Ontario*

FEW REPORTS HAVE been published on the fishes of the lower Saint John River (Scott and Crossman 1959). This paper reports on a series of collections from near Browns Flat, Kings County, N.B.

During the period August 9-14, 1964 a number of seine hauls were made in the Saint John River, along the shore and in mouths of brooks draining into the river, in the Browns Flat area (see Figure 1). Twenty-three species (600 specimens) were obtained. At least seven other species are definitely known to occur in the immediate area, bringing the total to at least thirty. Two other stations in the same area made in 1956 and 1963 are mentioned. All specimens are now in the National Museum of Canada and were identified by Dr. D. E. McAllister, Curator of Fishes. The species which were not collected but which are known to be common in the Browns Flat area are also mentioned.

The most recent work on freshwater fishes of New Brunswick (Scott and Crossman 1959) lists forty-six species, but a number of these are not known in the Browns Flat area. Squires (1950) in an unpublished manuscript also deals with the freshwater fishes of New Brunswick. Scott (1958) is the basic checklist for the freshwater fishes of Canada. McAllister (1960) lists the marine fishes of Canada. It will be noted that a number of species which were taken in the Saint John River (Browns Flat) are listed in both freshwater and marine checklists. Scott (1954) deals with the freshwater fishes of eastern Canada and includes photographs or figures of a number of species which are known from the Browns Flat area.

The American Fisheries Society's (1960) names are followed except in regard to the common and scientific names of the smelt (*see* McAllister, 1963) and in regard to the scientific name of the yellow perch (*see* Svetovidov and Dorofeeva, 1963).

I wish to thank Dr. D. E. McAllister and Mr. F. R. Cook for reading the manuscript and for their interest and co-operation. Also I wish to thank my family for assistance in collecting.

Petromyzon marinus, SEA LAMPREY. No specimens were collected. This species is seen occasionally in the spring at the mouth of Jones Creek Brook, Central Greenwich and Flaglor Brook, near Oak Point, and is known in this region as "lamper eel".

Acipenser oxyrhynchus, ATLANTIC STURGEON. Two specimens were collected (NMC64-421A), both being taken in salmon nets. This species is common in the Saint John River during the summer season and is still fished to some extent commercially but not as extensively as twenty or thirty years ago. Sturgeon cause considerable annoyance to salmon fishermen by getting into the nets and since sturgeon under four feet in length cannot be sold commercially the fishermen have to throw back a good number.

Acipenser brevirostrum, SHORTNOSE STURGEON. Eight specimens were collected (NMC64-421A), all being taken in salmon nets. Although fairly common in the Saint

*Present address: New Brunswick Museum, St. John, N.B.

TABLE 1. — The following is a list of stations and hauls, see map (Figure 1), with National Museum of Canada catalogue numbers. All collections were made with a seine, with the exception of G 3 (with salmon net) and G 6 and G 7 (with fishing line).

Station	Haul	Catalogue Number	Date	Locality	Depth of water	Bottom	Tide
G 1	1	NMC64–413	9/8/1964	Browns Flat, Saint John River, Gorhams' shore about ½ mile below Glenwood Wharf	6″–3′	red clay, rocks, some gravel	nearly high
G 1	2	NMC64–414	,,	,,	,,	,,	,,
G 1	3	NMC64–415	,,	,,	,,	,,	,,
G 1	4	NMC64–416	,,	,,	,,	,,	,,
G 2	1	NMC64–417	12/8/1964	Central Greenwich, at mouth of Jones Creek Brook where it empties into Saint John River	6″–1′	clay, rocks, some gravel, and sand	above summer high tide level
G 2	2	NMC64–418	12/8/1964	Central Greenwich, Saint John River at mouth of Jones Creek Brook	1′–2′	clay, gravel and rock	nearly high
G 2	3	NMC64–419	,,	,,	,,	,,	,,
G 2	4	NMC64–420	,,	,,	,,	gravel with some mud	,,
G 2	5	NMC64–421	,,	,,	1′–3′	muddy	,,
G 3		NMC64–421A	12/8/1964	Saint John River, eastern shore about one mile above Cedars Wharf	6′–?12′		
G 4	1	NMC64–422	14/8/1964	Flaglor Brook, under bridge on Hwy. 2 near Oak Point	1′–3′	gravelly	above summer high tide level
G 4	2	NMC64–423	,,	,,	,,	,,	,,
G 4	3	NMC64–424	,,	,,	,,	,,	,,
G 5		NMC64–425	14/8/1964	Browns Flat, Saint John River at mouth of Anderson Brook, opposite Catons Island	6″–2′	mud and clay	nearly high
G 6		NMC58–316	18/7/1956	Saint John River at Glenwood Wharf	8′	mud and rock	
G 7		NMC64–660	19/8/1963	Browns Flat, in a spring-fed brook about one mile north of Browns Flat and ½ mile south-west from Glenwood		ledge	

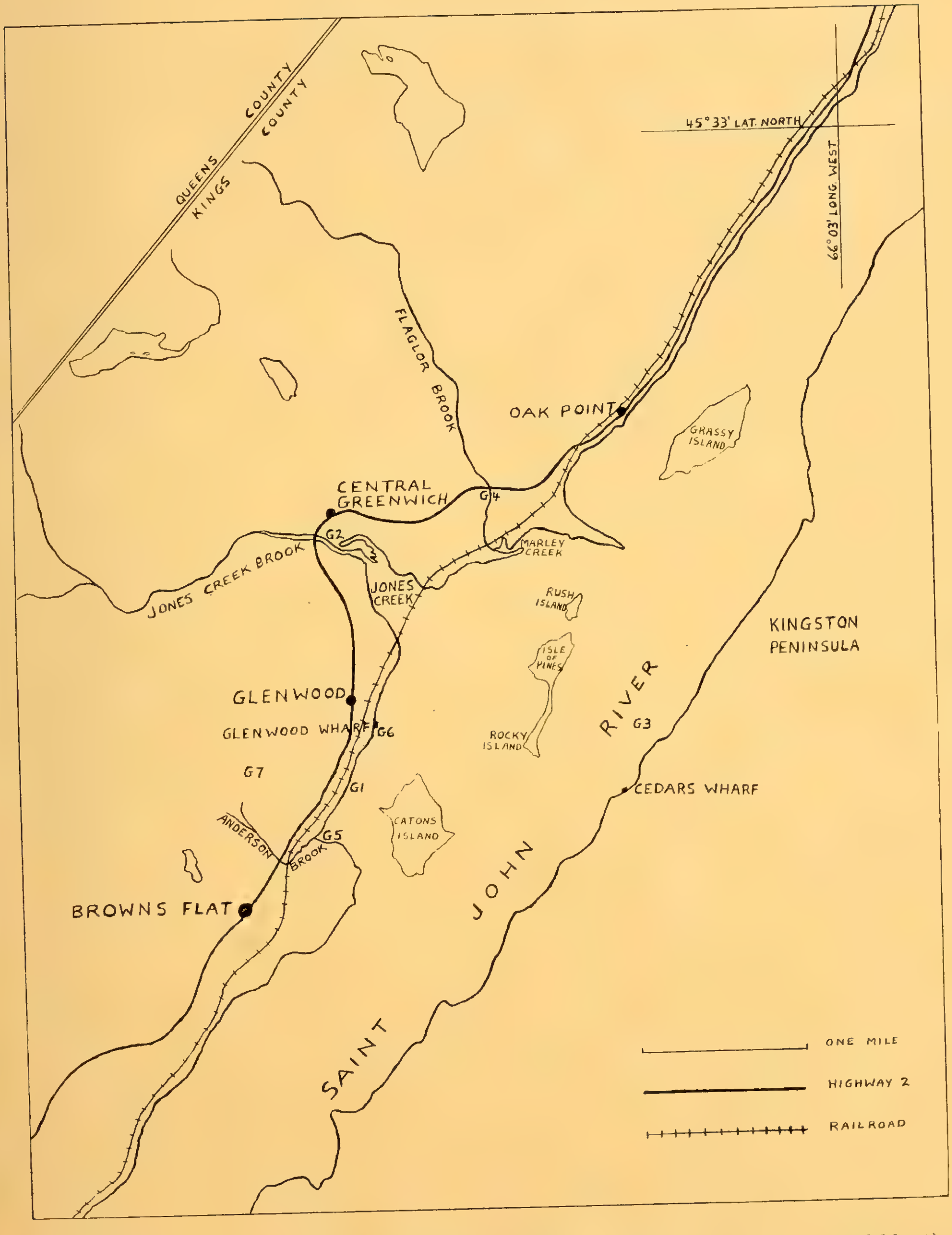

FIGURE 1. Map of Browns Flat Area showing collecting stations G1 – G7 (see Table 1).

John River, Browns Flat area, the first definite published report of this species for the river appears to be that of Leim and Day (1959) from a specimen taken near the mouth of the river (approximately 25 miles south from the Browns Flat area). Vladykov and Greeley (1963) had seven adult females, three adult males and three heads all from the vicinity of Gagetown (Saint John River) N.B., which is about 35 miles north of the Browns Flat area. Owing to the smaller size of this species and the four foot minimum length not many are retainable for commercial purposes.

Alosa pseudoharengus, GASPEREAU. No specimens were collected. Gaspereau are very numerous in the spring after the ice breaks up in the Saint John River in Browns Flat area and are fished commercially with gill nets.

Alosa aestivalis, BLUEBACK HERRING. No specimens were collected. Although the author cannot be absolutely sure, it appears likely that this species occurs in the Saint John River, Browns Flat area. On several occasions fish looking much like gaspereau but having a very bluish back were sold by commercial fishermen as "gaspereau". They were taken in gaspereau nets while the "run" was on. One particular lot which the author remembers was taken at Jones Creek in the Saint John River some seventeen years ago (in a gaspereau net) by a commercial fisherman.

Alosa sapidissima, AMERICAN SHAD. Thirteen specimens were collected: four (NMC-64-413), nine (NMC64-425). The American shad appears in numbers in the Saint John River, Browns Flat area during May and June, and is fished commercially with gill nets.

Salmo salar, ATLANTIC SALMON. One specimen was collected (NMC64-421A). During the summer months the most valuable commercial fish in the Browns Flat area of the Saint John River and is rigidly protected during the closed season.

Salvelinus fontinalis, BROOK TROUT. Two specimens were collected (NMC64-422). The brook trout is common in the brooks and lakes of the Browns Flat area.

Coregonus clupeaformis, LAKE WHITEFISH. No specimens were collected. This species has been taken in the Browns Flat area in the Saint John River.

Osmerus eperlanus mordax, RAINBOW SMELT. No specimens were collected. This species is very common in the Saint John River during January, February and March in the Browns Flat area, and is caught on fishing lines through the ice, for the most part not commercially.

Esox niger, CHAIN PICKEREL. One specimen was collected (NMC64-420). This species is fairly common in the Saint John River during the spring months, especially so at Jones Creek. It was formerly fished to some extent commercially by gill net.

Catostomus commersonii, WHITE SUCKER. One hundred and twenty-three specimens were collected: three (NMC64-413), 51 (NMC64-417), one (NMC64-422), one (NMC64-423), two (NMC64-424), 65 (NM-C64-425). The white sucker is very common in the Saint John River, Browns Flat area, near creeks and mouths of brooks. Many are taken in gaspereau nets during the spring but are of little commercial value.

Catostomus catostomus, LONGNOSE SUCKER. Three specimens were collected (NMC64-423). This species is not as common as the white sucker in the Browns Flat area.

Notemigonus crysoleucas, GOLDEN SHINER. Eighty-two specimens were collected (NM-C64-425).

Semotilus atromaculatus, CREEK CHUB. Two specimens were collected (NMC64-425).

Semotilus corporalis, FALLFISH. Eighteen specimens were collected: two (NMC64-417), six (NMC64-418), seven (NMC64-422), three (NMC64-423).

Hybopsis plumbea, LAKE CHUB. One specimen was collected (NMC64-416). The lake chub is very common in the river along the shores and in the lakes.

Rhinichthys atratulus, BLACKNOSE DACE. Three specimens were collected (NMC64-422).

Notropis cornutus, COMMON SHINER. Two hundred and seventy-six specimens were collected: one (NMC64-413), one (NMC64-415), nine (NMC64-417), one (NMC64-

418), 18 (NMC64-422), three (NMC64-423), six (NMC64-424), 237 (NMC64-425).

Notropis heterolepis, BLACKNOSE SHINER. Five specimens were collected (NMC64-425).

Ictalurus nebulosus, BROWN BULLHEAD. No specimens were collected. This species is found in the Browns Flat area of the Saint John River and is known locally as "catfish".

Anguilla rostrata, AMERICAN EEL. Three specimens were collected: two (NMC64-425), one (NMC58-316). The American eel is common in the Saint John River in the Browns Flat area. It is often taken on fishing lines around wharves and was formerly fished commercially but now to a lesser extent.

Fundulus diaphanus, BANDED KILLIFISH. Seven specimens were collected (NMC64-425).

Lota lota, BURBOT. No specimens were collected. This species is known occasionally from the Browns Flat area of the Saint John River.

Microgadus tomcod, ATLANTIC TOMCOD. No specimens were collected. This species is very common in the Saint John River, Browns Flat area, during January, February and March when they are caught on fishing lines through the ice, usually in the same location where smelt are taken. They are known locally as "tommycod".

Roccus americanus, WHITE PERCH. Two specimens were collected (NMC58-316). The white perch is fairly common in the Browns Flat area of the Saint John River and is caught mostly by sport fishermen around wharves, etc.

Roccus saxitilis, STRIPED BASS. No specimens were collected. This species is known from the Browns Flat area of the Saint John River, being occasionally caught in salmon nets, and is called "sea bass" locally.

Lepomis gibbosus, PUMPKINSEED. Seventeen specimens were collected: eight (NMC64-414), two (NMC64-415), six (NMC64-425), one (NMC58-316). The local name for this species is "sunfish".

Perca fluviatilis flavescens, YELLOW PERCH. Seven specimens were collected: one (NMC 64-414), two (NMC64-415), two (NMC64-416), two (NMC58-316). This species is very common in the Saint John River, Browns Flat area.

Cottus cognatus, SLIMY SCULPIN. One specimen was collected (NMC64-660).

Gasterosteus aculeatus, THREESPINE STICKLEBACK. Two specimens were collected (NMC 64-416).

Apeltes quadracus, FOURSPINE STICKLEBACK. Fifteen specimens were collected: three (NMC64-415), three (NMC64-416), two (NMC64-419), two (NMC64-420), five (NMC64-421).

Sixteen of the twenty-three species were taken only in river hauls; two species (white sucker and common shiner) were taken in both river and brook hauls; one species (fallfish) was taken in three brook hauls and one river haul; and four species (brook trout, longnose sucker, blacknose dace and slimy sculpin) were taken only in brooks. Stations G 2, h 1; G 4, h 1-4 and G 7 are from brooks draining into the Saint John River, two of the stations being within ¼ mile or less of the river and not under the influence of tide during the summer. All other stations are from the Saint John River itself with half of these being near the mouths of brooks draining into the river but all are continuously under the influence of tide.

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STUDIES OF THE BYRON BOG IN SOUTHWESTERN ONTARIO XXII. OBSERVATIONS ON TOADS, FROGS AND TURTLES

WILLIAM W. JUDD
Department of Zoology, University of Western Ontario, London, Ontario

IN THE DESCRIPTION of the Byron Bog (Judd, 1957) it was pointed out that there are three zones in the area. They are designated as A, B and C on the map accompanying the description and their outer limits are shown on the map. Zone A is the central floating bog based on a mat of *Sphagnum* moss and covered almost completely by leatherleaf, *Chamaedaphne calyculata*. Zone B is a low, wooded region, damp or flooded, with hardwood trees and shrubs at its outer limits and black spruce and larch at its inner limits. Zone C consists of wooded slopes occupied by deciduous trees and shrubs. In the floating bog (A) is Redmond's Pond (D).

Starting in 1956 various aspects of the biology of the bog, mainly concerning insects, have been studied by the writer. Since 1956 field notes have been made on toads, frogs and turtles and several specimens have been collected and

are reported herewith. Measurements of specimens (body length of toads and frogs, carapace length of turtles) were made as shown in Conant (1958). Specimens preserved in the collection of the Department of Zoology, University of Western Ontario are designated UWO.

Bufo americanus Holbrook, AMERICAN TOAD. Toads were found hopping over the *Sphagnum* moss and among leatherleaf bushes in Zone A. A small one (¾ in., UWO) was captured on July 23, 1956 and a large one (3¼ in., UWO) on May 5, 1964. Two small ones (1⅛ in., ⅞ in., UWO) were captured on May 14, 1964. Males were regularly heard trilling around the edge of Redmond's Pond in spring, e.g. April 27, 1962.

Hyla crucifer crucifer Wied, NORTHERN SPRING PEEPER. Chorusing began in March and April around Redmond's Pond and in the temporary pools in Zones A and B. Two small ones (both ½ in., UWO) were caught on *Sphagnum* moss in Zone A on July 21, 1956.

Hyla versicolor Le Conte, EASTERN GRAY TREEFROG. Calling from trees and shrubs in spring, e.g. May 5, 13, 1962. Two small ones (both ¾ in., UWO) were caught while crawling on twigs of leatherleaf in Zone A on July 25 and August 9, 1956 and were bright green in colour. A large specimen (1¾ in., UWO) was caught on May 25, 1962. It was kept in a one-gallon jar with twigs and moss and was fed on spiders, harvestmen and flies and died on March 8, 1963.

Pseudacris triseriata triseriata Wied, WESTERN CHORUS FROG. Chorusing began in March and April around Redmond's Pond and in temporary pools in Zones A and B. Two frogs (½ in., ⅝ in., UWO) were caught while hopping on *Sphagnum* moss in Zone A on July 7, 1956.

Rana clamitans melanota (Rafinesque), GREEN FROG. This was the commonest frog in the bog and was seen frequently in the water at the edge of Redmond's Pond and on moss adjacent to the pond and other pools. One frog (2¾ in., UWO) was captured on August 14, 1956 on moss in Zone A and another (4 in., UWO) was caught on June 6, 1964 in water in a ditch in the north east part of Zone B. Conant (1958) gives 4 inches as the record length attained by this species.

Rana sylvatica LeConte, WOOD FROG. Wood Frogs were seen in the damp woods in the easterly portion of Zone B. One was noted there on April 7, 1962, another on October 6, 1963 and a third (1 in., UWO) was captured on April 26, 1964.

Rana pipiens Schreber, LEOPARD FROG. Leopard Frogs were second in abundance to Green Frogs. They were seen in the water around Redmond's Pond but more commonly were found leaping over *Sphagnum* moss in Zone A and among bushes in the more open areas of Zone B. One (1 in., UWO) was caught on July 26, 1956 and another (2½ in., UWO) was found leaping on the moss in the southwest part of Zone A on May 30, 1964.

Rana palustris LeConte, PICKEREL FROG. Only one pickerel frog was found on the bog. It was captured on June 8, 1956 while leaping on moss in the north-west part of Zone A. It measured 2½ in. (UWO) and the inner thighs were bright yellow.

Chelydra serpentina serpentina (Linnaeus), COMMON SNAPPING TURTLE. On July 2, 1962 a turtle was crawling in a ditch in the northeast part of Zone B. Its carapace was estimated to be 12 inches long. On May 10 and 11, 1964 a turtle was seen on the north shore of Redmond's Pond and slid into the water. On May 30, 1964 a left humerus of a Snapping Turtle was found on the moss on the north shore of Redmond's Pond and measured 6.5 cm in length. A prepared skeleton of a Snapping Turtle, examined in the university museum, has a left humerus 5 cm long and a carapace 8 inches long. The turtle from which the loose humerus came was thus likely considerably larger than this.

Emydoidea blandingi (Holbrook), BLANDING'S TURTLE. On April 27, 1963 one turtle was on a board floating at the southeast corner of Redmond's Pond. It was studied with binoculars from the northwest corner of the pond. The dark gray carapace was strongly arched and estimated to be 8 inches long. The top and sides of the head and neck were gray and the bottom of the lower jaw

and neck were bright yellow. It remained in the one position for about one hour.

Chrysemys picta marginata Agassiz, MIDLAND PAINTED TURTLE. This was the commonest turtle in the bog. On summer days five or six could often be seen at once on logs and boards on Redmond's Pond. One was walking in the woods in the southeast part of Zone B on May 28, 1962. Early dates of sighting of turtles at Redmond's Pond were April 15, 1962, April 27, 1963 and April 26, 1964. On June 9, 1964 a turtle (5¼ in., UWO) was found at the edge of a field at the top of the southern part of the wooded slopes in Zone C. It had dug in the soil a hole with an opening one inch in diameter and two inches deep. When it was first seen its anal opening was over the hole and the hole was surrounded by damp mud. It was evidently preparing to lay eggs but moved off when disturbed. On October 17, 1964 a turtle (5½ in.) was sprawled in the sun a few inches above the water on branches of leatherleaf hanging over the north end of Redmond's Pond. A small one (2½ in.) was found on the same day in a ditch in the northeast part of Zone B and its carapace and plastron were deeply stained with red rust derived from old iron hardware lying in the water.

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Letter to the Editor

We of the Kenora District were pleased to see that someone has seen fit to collect and publish an article on our small mammals (*see* Canadian Field-Naturalist 78 (3): 197-199).

We, however, take affront at the author's knowledge of geography. Anyone who denotes this District as a portion of "Southwestern Ontario" should be given a taste of our present sub-zero weather to correct his interpretation of "south" and "north".

G. F. COYNE

District Forester
Department of Lands and Forests
Kenora, Ontario
12 January 1965

The World of Birds

By JAMES FISHER and ROGER TORY PETERSON. Doubleday and Company, Garden City, New York. 1964. 288 pp. including 90 with color plates depicting almost 700 bird species; also ca. 200 colored distribution maps, many half-tones. ($25.50).

Fisher and Peterson are a combination from whom we expect an outstanding product and that is precisely what "The World of Birds" proves to be. It is big (but not ponderous), extremely handsome, readable, and authentic. Its presentation is fresh and colorful. Its scope includes just about any aspect of bird biology the reader ordinarily wants to pursue.

The book has four principal sections. The first outlines ornithology as a science and by means of an extremely effective combination of pictures and words it discusses very many aspects of bird biology too numerous to mention here. The second section is a 47-page discussion of bird watching, its techniques, tools, and objectives with useful information on field identification, notebooks, field glasses, cameras, lenses, photography, sound recordings, lists and listing, local records, censuses, sea logs, bird banding, methods of studying migration (including radar), nest record schemes, life history and behavior studies, sanctuaries, bird protection, and bird clubs.

The third section is a very useful and interesting classification and mapping of the geographic distribution of the world's bird families, with a count within each family of the number of genera and species, these in turn segregated into fossil, recently extinct, and living. Such a mapping of all the world's bird families apparently has not been done in any other book. The fourth section deals with the manifold relationships of birds and man and looks effectively at the many problems of bird conservation.

There is a red (for danger!) list, briefly but effectively annotated, of 143 bird species believed to be still living but whose total numbers may be, or recently have been, only 2000 individuals or less. There is also a black list of 85 species believed to have become extinct since 1600. Although scientific names do not clutter the main text, these are wisely provided appositively with the English names in the index. A useful bibliography of selected references to the ornithological literature in various parts of the world is given.

This impressive assemblage of reliable information is well organized, informally written in relatively simple terms, and is lavishly, cleverly, and colorfully illustrated. The pictures-words presentation is extremely effective. Peterson's bird portraiture is absolutely superb. Also he again demonstrates his outstanding ability to illustrate diagrammatically more abstract subject material.

W. EARL GODFREY

National Museum of Canada
Ottawa, Ontario

Life Histories of North American Birds

By ARTHUR CLEVELAND BENT. 20 vols. Dover Publications, Inc., New York (in Canada, General Publishing Co. Ltd., Toronto). 1964.

Bent's great 20-volume *Life Histories of North American Birds*, one of the most useful works in the literature of North American ornithology, was originally published as bulletins of the United States National Museum. Stocks of each volume were quickly sold out shortly after the volume appeared, and those who did not buy them promptly soon found themselves wishing they had. Prices of the early volumes soared in some cases to ten times their original price—when indeed they could be had at all. Many amateurs were fortunate enough to have access to libraries that possessed the series. Others

who live in smaller towns or in the country never seem to have familiarized themselves with this indispensable compendium and do not know what they are missing.

Fortunately all the volumes of this classic are again available. Dover Publications has republished them, completely unaltered and unabridged including all illustrations, in well-made volumes, and at reasonable prices.

Subjects of the volumes available are:

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- Cuckoos, Goatsuckers, Hummingbirds, etc.
- Jays, Crows, Titmice
- Thrushes, Kinglets, etc.
- Nuthatches, Wrens, Thrashers, etc.
- Wood Warblers
- Blackbirds, Orioles, Tanagers, etc.

Individual volumes are obtainable separately, the price per volume varying between $2.90 and $3.20.

W. EARL GODFREY
National Museum of Canada
Ottawa, Ontario

Studies in the Life History of the Song Sparrow

By MARGARET MORSE NICE. Republished 1964. Dover Publications, Inc., New York. Vol. 1: 246 pp.; Vol. 2: 328 pp. ($2.05 each volume).

It is a pleasure to note that Mrs. Nice's painstaking and classic studies of the Song Sparrow, *Melospiza melodia*, are once again available through republication. Volume 1 was originally published in 1937, and Volume 2 in 1943, as Volumes 4 and 6, respectively, of Transactions of the Linnaean Society of New York. Volume 1 is an intimate eight-year study of the Song Sparrow's population aspects, environment, ecology, migration, territory, reproduction, and survival problems. Volume 2 (reviewed *Canadian Field-Naturalist* 58:65) is an outstanding treatise on the behavior of passerine birds with the Song Sparrow as the main example. The Dover reprints are unabridged, clearly printed on good paper, and appear to be well-made and durable. Everyone seriously interested in birds should possess these inexpensive classics.

W. EARL GODFREY
National Museum of Canada
Ottawa, Ontario

The Story of My Pelican

By ALBERT SCHWEITZER. (Translated by Martha Wardenburg). Ryerson Press, Toronto. 1964. 36 black and white photos by Anna Wildikann. 70 pp. $2.35.

This is the story of the rearing, by Dr. Schweitzer, of three young pelicans as allegedly told by one of the pelicans. Although highly anthropocentric and obviously not intended to be of scientific value (even the pelican species is not identified), it is a wholesome little story told with a charming simplicity and humour that will appeal strongly to children and doubtless many adults, too. The numerous photographs, by Anna Wildikann, are amusing and complement the story well.

W. EARL GODFREY
National Museum of Canada
Ottawa, Ontario

Three Bird Immigrants from the Old World

By J. L. BAILLIE. 1963. Transactions of the Royal Canadian Institute 34 (Part 2), pp. 95-105.

This is a detailed, well-documented history of the status in the New World, and in Ontario in particular, up to 1963 of three species of Old World birds. The first known nesting in North America of the Little Gull, *Larus minutus*, was dis-

covered at Oshawa, Ontario, in 1962. The first known breeding records of the Cattle Egret, *Bubulcus ibis*, in Ontario occurred in 1962 at Luther Marsh, Wellington County, and off Presqu'ile, Northumberland County. The Black-headed Gull *Larus ridibundus*, has in recent years been observed in small numbers, but regularly, in North America, although it is not yet known to nest on this continent.

W. EARL GODFREY

National Museum of Canada
Ottawa, Ontario

Dictionary of Herpetology

By JAMES A. PETERS. Hafner Publishing Co., New York. 1964. 392 pp. $11.50.

The printing of this dictionary of herpetological terms is a major step towards unifying an expanding science whose early disciples had to develop their own vocabularies. This inevitably led to many synonymous terms. Over three thousand words now in use in herpetological literature are defined in Dr. Peters' *Dictionary*, and in most instances there is a reference citation to the paper in which the term was first employed. This latter innovation adds immeasurably to the value of the book. The author has not taken it upon himself to state which of several synonymies is the one that should be used and which discarded, but he has indicated which term is most often employed by herpetologists.

Following the text portion are thirty-two pages of drawings and diagrams labelled with all synonymous morphological terms. It is shocking to discover that no less than nine terms have been used at different times to denote the chelonian acromial process. Other diagrams illustrate the various methods of measuring the bodies, shells, legs, tails and scales of amphibians and reptiles.

The author has provided blank pages for additional notes in order that other herpetologists can both add to this dictionary over the years and also note corrections or deletions in the present volume. One immediate correction concerns Dowling's original paper on ventral count method for snake scales, the reference is not in Copeia, but is Dowling, 1951, British Journal of Herpetology 1 (5):97-99.

Both professional herpetologists and novice students will find this *Dictionary* of great value in their writing and reading, and with their continued support of such a standard reference, herpetology will hopefully become a more precise science.

J. SHERMAN BLEAKNEY

Biology Department
Acadia University
Wolfville, N.S.

Physiology of the Amphibia

By JOHN A. MOORE, Editor, Academic Press, New York. 1964. 654 pp. $18.00.

Our accumulated knowledge of the physiology of amphibians has reached a stage where no one man could be expected to write on the entire topic with any appreciable depth. Consequently, the editor of this volume, Dr. J. A. Moore, had ten specialists contribute the ten chapters. The chapter headings are—The Metabolism of Amphibia, The Digestive System, Blood and Respiration, Physiology of Amphibian Heart, Water Balance and Kidney, Amphibian Muscle, Endocrinology of the Amphibia, Metamorphosis, The Developmental Physiology of Amphibia, and Regeneration. Each chapter has its own extensive list of references and at the end of the book there is a comprehensive author index, species index and subject index.

As a compendium of amphibian physiological information this volume will be indispensable to professional physiologists. It will also be of value to teachers of embryology and anatomy and even first year zoology, as a source for detailed information on those vexing basic phenomena which the beginning student often recognizes but which the research student has not yet explored. On this

latter point of neglected research the editor in his preface states, "One of the more interesting things that impressed the contributors to this volume is the many and large gaps that still remain in our knowledge of amphibian physiology. Far from closing the field with these chapters, therefore, we hope to have shown how really open it still is."

As the Canadian Field-Naturalist is intended for a broad audience interested in science and nature it would seem appropriate in this review to mention an unfortunate situation that bears directly upon amphibian physiological research, namely, rarely can physiologists, anatomists or embryologists be considered herpetologists or taxonomists. Thus, a physiological enquiry conducted upon *a* frog is often reported as *the* frog. If the experiment is repeated in another geographic area contradictory or inexplicable results are often obtained. No herpetologist would be surprised at this for he knows that there are many frogs and salamanders of different genetic constitution and that they are adapted physiologically to various habitats. However, although the physiologists may not fully appreciate the diversity in natural populations from different areas, a field biologist may in his turn not fully appreciate the contribution of the physiologist to the understanding of natural populations. A perusal of the chapters on Blood and Respiration, Water Balance and Kidney, and Metamorphosis should make any taxonomist realize that the morphological and morphometric characteristics which distinguish his habitat-specific forms are rough yardsticks compared to the delicate measurements of blood chemistry and muscle physiology which are the basic adaptive features that make it possible for a species to occupy a specific niche. The increased use of electrophoretic analysis in population studies is an encouraging sign of combined field and laboratory techniques.

Dr. J. A. Moore did much to promote the adoption of laboratory techniques of experimental physiology through his own work in determining the temperature tolerance limits and growth rates of eggs of North American ranids and relating this data to field observations. In editing this present volume he has made another major contribution through having a vast array of scattered literature brought together in one book for the benefit of all biologists.

J. SHERMAN BLEAKNEY

Biology Department
Acadia University
Wolfville, Nova Scotia

Fishes of the Western North Atlantic

By H. B. BIGELOW, D. M. COHEN, M. M. DICK, R. H. GIBBS, JR., M. GREY, J. E. MORROW, JR., L. P. SCHULTZ and V. WALTERS. Memoir of the Sears Foundation for Marine Research, Number 1, Part 4. 1964. 599 pp. 155 fig. 2 maps. $27.50.

This volume, the fourth in the series, covers the little known oceanic groups Argentinoidea, Stomiatoidea, Bathylaconoidea and Giganturoidei, as well as those freshwater Esocoidea (endings *sic*, see below) which sometimes enter brackish water. In the former fishes may be found remarkable adaptions to the conditions of deeper waters such as photophores (light producing organs) with lens and reflector, ultra-sensitive tubular eyes, enormous jaws whose length exceeds the length of the rest of the head, luminous-tipped lures of bizarre shape, long chin barbels up to eight times the length of the body.

Some of the fishes are handsomely depicted, e.g. the tubular-eyed *Opisthoproctus grimaldii* (fig. 19) by Mildred Carrington and the skulls of giganturid fishes (fig. 153) by Samuel B. McDowell, Jr. a few illustrations have been published previously and some are substandard. Unfortunately some of the species are not illustrated.

One of the great virtues of this series has been its cosmopolitan approach, despite its titular restriction to the western North Atlantic. Taxa may be keyed to

genera and sometimes species even when they may be extralimital. These volumes will be valuable to workers in other parts of the world.

The survey of pertinent Canadian literature is generally less thorough than that of the American literature. For example, there is no note of the Canadian records of *Bathylagus euryops* (published as *benedicti*), of *Borostomias*, of *Malacosteus niger*, nor of *Idiacanthus fasciola*, although the references reporting these records were repeated in the *List of the marine fishes of Canada* (McAllister, 1960, National Museum of Canada Bulletin 168). Another criticism is that certain authors have not included in their study material as great or as geographically broad a representation of specimens of certain species (in which adequate material is extant) as is requisite for good species descriptions. It is a shame to write a monograph of this size and not go to a little extra trouble to examine adequate material and produce the best illustrations. It is unfortunate that Dr. E. J. Crossman who is monographing the Esocoidei was not asked to co-author or author this group. It may be noted that suprafamilial endings, -oidea, are incorrectly used for orders.

The section on the Order Giganturoidei by V. Walters is particularly valuable because of the anatomical descriptions. The clear and error free writing which graces this volume is a tribute to the authors, and to the editor's vigilance.

Because of the small size of the edition (1500 copies), libraries and interested individuals would be wise to obtain copies soon. Because of its great value in encompassing so much literature and so broad a geographical area the edition will probably be exhausted early, despite the high cost per volume. In the event that the edition is exhausted, the Sears Foundation might consider the possibility of reprinting it in a quality paper back binding.

D. E. McAllister

National Museum of Canada
Ottawa, Ontario

Orchids of the Western Great Lakes Region

By Frederick W. Case Jr. The Cranbrook Institute of Science, Bloomfield Hills, Michigan. 1964. xii + 147 pp., 8 double colour plates and frontispiece, 24 black and white plates (many double), 52 half-page distribution maps (pp. 111-137) with key map identifying counties by name. $7.00 (U.S.).

Mr. Case is a graduate botanist, with a master's degree from the University of Michigan, who teaches biology and natural science in Saginaw, Michigan. His students are very fortunate indeed, since in addition to being a botanist and teacher, he is an eager and enthusiastic naturalist with a wide field of interest and the ability to fire others with his enthusiasm.

This new book on the orchids of a specific region is a very valuable contribution to the literature, and an essential aid for the amateur field botanist. For residents of Ontario and southwestern Quebec it is a highly recommended purchase. Orchid hunters in these regions have been forced to refer to the very rare copies of Morris and Eames, *Our Wild Orchids*, which has been out of print for 25 years, or to use Correll, *Native Orchids of North America North of Mexico*, a magnificent book, but essentially taxonomic and therefore difficult for beginners. The other reference works freely available, Gray's Manual and Britton and Brown's Flora, are hardly field books, and while useful, though difficult, for the amateur, provide an absolute minimum of information.

Mr. Case's book includes an extensive introduction which should whet the appetite of any interested reader, and there is a long bibliography to help satisfy this appetite. After a brief introduction to the orchid family, with a description of the structure of orchid flowers and the evolution of orchids and their pollination, the author presents a chapter on orchid ecology which is the finest short introduction to the subject which this re-

viewer has encountered. Discussions of changes in wild orchid populations and of soil habitat requirements in this section are most interesting and intriguing, and should help the amateur orchid hunter to begin to make sense of very complex matters and to lead him into something more than simply identifying his finds. The following chapter on the origins and distribution patterns of Great Lakes orchids continues this theme, and suggests the value of recorded amateur re-observation of orchid sites over the years as a contribution to the study of plant geography and dissemination. This chapter also gives a description of nine orchid habitats and the species typical of them, a most useful aid for the orchid hunter in the field. It is followed by a detailed review of methods for growing native orchids which is thorough and specific.

The main portion of the book is devoted to identification keys and detailed species by species discussions. It is very well written, and gives a large amount of useful information on distribution, flowering times, habitat, and hybrids. The keys are outstandingly good, each one being illustrated by line drawings of the flowers with important discriminating features indicated by arrows. The amateur will find these keys a joy to use, especially for such notoriously difficult genera as *Spiranthes* and *Goodyera*.

There is a half-page distribution map for each species. The map covers the area from just west of the western tip of Lake Superior to a few miles east of Toronto, and from north of Lake Superior to south of Lake Erie. Occurrences are indicated by a single dot in each county, so that range is shown, but not density of records. The maps were compiled by examination of important herbaria and by field exploration. Mr. Case has managed to find and photograph all the 52 species he treats, quite an achievement in itself. Canadian readers will notice the lack of records from many Ontario locations where orchids obviously grow. The author's plea for the deposition of preserved specimens in important herbaria should be heeded.

Mr. Case quite rightly emphasizes the utility of field photographs of the plants, and reproduces photographs of all the species which are fully treated, many in colour as well as black and white. Unfortunately, many of the photographs, as reproduced, are of poor quality. The major fault is poor depth of focus, so that in a number of pictures the flowers show almost no detail. This is an unwelcome feature in a book otherwise of excellent quality. It is worth noting that several photographs in the review copy had been smeared through poor handling, perhaps in the press room. Anyone buying the book should examine the plates and reject damaged copies.

Having made this one criticism, the reviewer urges any eastern Canadian orchid hunter, or indeed any in the northeast corner of the continent, to rush right out and get a copy of this book. Only a very few orchid species in this whole region are not described, and most readers will not be likely to come across the missing items. In addition, the book is reasonably small and highly portable. It would be worth having a special pocket built on a bush jacket to have it handy at all times.

E. W. GREENWOOD
Ramsayville, Ontario

The Orchids of Nova Scotia

By J. F. DONLY. K. & W. Enterprises, Liverpool, N.S. Sept. 1964, privately printed in 24 copies. 57 pages, 35 figs.

"The sole excuse for this book"—in the modest opinion of its author—"is to help the interested amateur to both familiarity with and enjoyment of these plants", creations "too pleasant to be looked upon except on holidays" (Izaak Walton).

In selecting familiar quotations to delighten his text, the author unintentionally reveals his own interests and ample

pursuits, those of conservationist, dedicated naturalist and compleat angler, as well as keen-eyed orchid hunter,—in all, proving that "Nature is a vast repository of manly enjoyments" (Henry Ward Beecher). In his study he has followed the sage advice of Shakespeare and has noted faithfully "the degree, priority and place" of each of the 46 different orchid entities in the Province. His area of familiarity extends also to Newfoundland and Ontario, and appropriate comparisons are drawn. The illustrations comprise numerous line-drawings, a fine color-print frontispiece, and a monochrome painting on the cover. In making this important and intimate contribution to natural history, Mr. Donly admits that he himself has gained a full deal of personal enjoyment, for which we envy him. Furthermore, he wishes to share that reward with others of like interest—but not with too many!

The reviewer's copy has been placed in the library of the Plant Research Institute, Department of Agriculture, Ottawa.

William G. Dore

Plant Research Institute
Central Experimental Farm
Ottawa, Ontario

Weeds of Canada and the northern United States

By F. H. Montgomery. The Ryerson Press, Toronto. 1964. viii + 266 pages, 244 figs. Cloth $4.95.

Weeds are the unwanted plants that seem always to be about us, in our garden beds, in our lawns and laneways, often where least we expect to find them. When we carve a fresh property out of the suburban bush or even set a window-box high on an apartment ledge, some weed is sure to appear, and thrive. More serious is it when weeds take over farmers' fields and choke their crops.

Getting to know the weeds, if for nothing more than the sake of naming them, can be an absorbing hobby. But for the most of us the purpose in knowing them is to know how to get rid of them. To be able to follow given directions for control it seems we first must know what weed species we are dealing with. Identification, then, is the prime aid of Professor Montgomery's book; specific recommendations for control are not given. Keys based on distinguishing characters, drawings, and detailed descriptions set in every-day terms are the means presented for identification. Over 360 of our most important weeds are treated.

In reading the book it is interesting to note that some weeds range across the country from coast to coast without respect for national boundaries, while others are restricted to a particular region or to some special habitat presumably because of climatic or soil requirements. Some may have arrived but recently and have not yet had chance to spread far from the site of their introduction. Most have come from Europe, very few from the Orient. Some, like common milkweed and ragweed, are native to North America but have 'gone wild' as weeds as forests have been cleared or the sod opened up. It is unfortunate that the noxious Field Thistle of Europe should come to acquire the name Canada Thistle, inaccurate as to origin and distribution as that name is.

The book in its approach and format is much like its author's *Native Wild Plants* published two years ago, and could be considered a companion volume to it. A superb colour portrait of bull thistle adorns the dust-jacket; in contrast, the text figures may appear drab. The drawings have appeared previously in an Ontario Department of Agriculture bulletin and residents of that province will not find much of benefit in the book except its handy pocket size.

William G. Dore

Plant Research Institute
Central Experimental Farm
Ottawa, Ontario

Wonders of Animal Migration

By JACQUELYN BERRILL. Dodd, Mead and Company, New York. 1954. 96 pages. $3.75.

In this book Mrs. Berrill says, "The wonder grows the more you think about it", and surely in these pages she has given the young reader much to think about.

The migrations of many creatures–the list includes ants, butterflies, birds, eels, turtles and whales–are described in a simple, interesting way that is sure to attract junior readers, and senior readers as well. Mrs. Berrill's own delightful sketches enliven nearly every page.

Migration is treated in a broad sense and a great deal of information is gathered together in the book's 90 odd pages. Unfortunately there are minor errors. One example illustrates the type. Salmon do not "spawn in the same *quiet* waters in which they grew" (italics mine).

Nevertheless, much can be learned from the book, and what is even more important, the feelings of curiosity, excitement and wonder which are aroused will stay with the reader long after the book is finished.

This is the type of book which, with the author's other seven "Wonder Series" books, will encourage many a young person to take a deep interest in the world of nature.

V. E. F. SOLMAN

Canadian Wildlife Service
Ottawa, Ontario

Other New Titles

Effects of Forest Fires on the Winter Range of Barren-ground Caribou in Northern Saskatchewan

By GEORGE WILBY SCOTTER. 1964. Canadian Wildlife Service, Wildlife Management Bulletin, Series 1, No. 18. 111 pp. + map. (Queen's Printer, Ottawa).

NOTES

Gull Breeding Records from Prince Edward Island

THE HERRING GULL (*Larus argentatus*), and the Great Black-backed Gull (*Larus marinus*), are common birds in this region of the Maritime Provinces. Godfrey (1954, National Museum of Canada Bulletin 132: 155-213) describes the former bird as a very common permanent resident, not known to breed,–a status apparently of long standing. In describing the second gull as a common to very common permanent resident, he comments on its obvious numerical increase during the then recent years.

Among four observers here from 1891 to 1947, two called *L. marinus* a winter bird, one reported it as being common in spring and autumn, and one failed to record it. None published a breeding record. The writer's observations since 1952 confirm the status of the Herring Gull but suggest that the larger gull has become more numerous. Coastal and inland populations in the spring consist largely of mature birds, and the proportion of sub-adults increases through the summer.

The coastal topography of Prince Edward Island provides abundant habitat for both gulls, and for the equally

numerous Common Tern; and because many apparently suitable breeding sites exist, it seemed to the writer unreasonable that breeding should not occur. Extensive beaches along coasts, bays, and rivers here are often backed by marshy or wooded areas, and are infrequently visited by man. Summer populations of gulls are found on barren, sandy points at river mouths and tidal inlets, and on most of the small, uninhabited islands in bays along the north coast. These places are seldom visited, and would seem to provide the isolation a breeding colony probably requires. Therefore, in search of breeding evidence the writer visited Bird Island in northwestern Malpeque Bay, and centrally located, Little Curtain Island in July and August, 1964.

The latter island, one by one-quarter mile, elevation from one to ten feet, is a sandy area bearing short marsh grass, sedges, and a few shrubs. Its low central area contains some salt water ponds, and is flooded by storm tides. On July 9, two colonies of about 600 Common Terns were located at the southern end, and some 800 Great Black-backed Gulls formed a large, dispersed colony around the northern end. About 75 Great Blue Herons left the ponded region at our approach, and some 20 ducks (probably Black Duck), were later flushed from various points on the island. No Herring Gulls were recorded at this time.

Of about 200 nests examined at the gull colony, approximately two-thirds contained from one to four eggs, and an estimated seven per cent of these clutches held the larger number. Twenty-five young birds were seen, ranging in development from downy chicks to birds almost fully fledged. A similar number of young were believed hidden in the long grass.

On August 1 rearing was still being conducted at a few nests. About ten contained eggs, some of them bleached; and of the twenty young birds observed, four large and five small were banded. Although most nests were deteriorating it appeared that the site was still being used for roosting. About 250 adult Herring Gulls and 250 Great Black-backed Gulls were in the vicinity, most of which remained on the water a half-mile from shore. Also present were about 250 unidentified immature gulls. A few score birds returned to nests when observations were concluded, while 100 moved to the adjacent beach or shallow water.

The two visits to Little Curtain Island represent the initial and terminal stages of the breeding period, and therefore the degree of recruitment this season cannot be determined. There was little evidence of mortality among eggs or birds, probably because of the scavenging habits of the species. Also, the gulls must prey heavily upon the nearby tern colonies, where scores of dead adults and young were observed.

Bird Island is a more fully consolidated land mass in a series of islands and barrier dunes opposing the Gulf of St. Lawrence. It measures about one by one-half mile, and is divided into a southern wooded half and a northern marshy area. On July 25 about 200 Herring Gulls were observed in the central portion of the marsh, at this time dry and firm. All the gulls were adults. Most of the 100 nests seen were among the short marsh grass, some were among rushes, and bushes on higher ground. As the colony was approached some thirty gulls were seen in spruce trees adjoining the marsh, and some birds returned to these locations when observations were concluded.

All nests were empty excepting two, which contained three eggs measuring about 2.6 by 1.7 inches. One large and six small chicks were banded, and a few remained under cover of vegetation. When avoiding capture the young birds pushed their heads into clumps of grass, ostrich fashion, leaving their bodies exposed. They apparently felt secure in this position, for it proved to be an effective means of quietening them after banding.

The adult gulls hovered over the nesting site during the observation, and most

returned to the ground as the writer departed. Some birds appeared to resume parental duties, others remained on the ground or flew around at low altitudes. Why the majority of the birds, clearly without nesting duties, should land at the site is unexplained, and this behaviour contrasts with that displayed by the Great Black-backed Gulls at Little Curtain Island.

At the northeastern shore of Bird Island were found the remains of a colony of Great Black-backed Gulls. This identification was based on the larger size of many nests and the presence of one *L. marinus* egg found in a nest. Some 60 widely dispersed nests were located along the upper beach, and at their southernmost positions they closely approached the Herring Gull colony. No young were seen, and the few dozen adults present were scattered around the island's shores.

Since this work Mr. Bruce C. Pigot, Mount Stewart, P.E.I., reported finding one nest of *L. marinus* near Gull Island in Savage Harbour,—a bay on the northeastern coast. At his observations on June 7 and 14, 1964, the nest contained two eggs, but it was empty on the final visit June 21. Complaining adult birds were present during each of his observations. Fox and raccoon tracks observed nearby suggested an explanation for the missing eggs.

The writer has recently learned of several locations in Prince County where unidentified gulls have bred for at least ten years. Most nesting sites of these two species are unprotected from the weather, and unattended nests are quickly destroyed by wind and drifting sand. A search for gull nests in other than the breeding season would therefore have little success.

Although these are perhaps the first published records of breeding for both gulls in Prince Edward Island, they almost certainly do not represent new or uncommon occurrences. They do indicate our limited knowledge of the local avifauna, and underscore the need for more exploratory work in this province.

STANLEY E. VASS

Ellerslie
Prince Edward Island
14 September 1964

Notes on the Migratory Tree Bats of Nova Scotia

RECORDS OF MIGRATORY tree bats from eastern Canada are exceedingly rare and have been summarized for New Brunswick by Gorham and Johnston (1962, Canadian Field-Naturalist 76 (4): 288). The total of published reports for Nova Scotia consists of but three records. Two of these are of Red Bats (*Lasiurus borealis*) both taken on ships far at sea to the south of Nova Scotia (Norton, 1930, Journal of Mammalogy 11:225 - 226; Brown, 1953, Canadian Field-Naturalist 67(3):139) and the third of an 1894 specimen of the Hoary Bat (*Lasiurus cinereus*) collected near Halifax. Smith (1940, American Midland Naturalist 24 (1):213-241) was the last to list records of all species of bats known from Nova Scotia and he included the 1894 report as the only migratory bat record. He neglected, however, to check the Nova Scotia Museum of Science where two additional records of Hoary Bats are in the card files; (1) from the County Jail, Halifax, N.S., November 17, 1909, and (2) found dead at base of lamp post, Dartmouth, N.S., October 22, 1917. The study skin of the latter specimen is still at the provincial museum and the file card mentions that this is the "4th specimen taken in N.S." The wing-span was recorded as 15.75 inches but no other measurements nor the sex were on the card.

The only Nova Scotia record of the Silver-haired Bat (*Lasionycteris noctivagans*) is an unreported study skin of an adult female in the study collection at the Nova Scotia Museum of Science.

It was shot at dusk by Lloyd Duncanson, of the museum staff, near Lake Kedjimkujik, Queens County, on July 10, 1950. I was present and recall that the bat flew a rather high straight course down a dirt road towards us and was passing directly overhead when shot. The dominant forest cover in that area was of maple, beech, oak, pine and hemlock.

Efforts to obtain more specimens of this elusive group of tree bats were made during the summer field seasons of 1959, 1960 and 1961, utilizing shot guns and mist nets. It is believed that Hoary Bats were seen on two occasions in Kings County, but the other two species were neither seen in flight nor captured. However, several fishermen on Brier Island, Digby County, had interesting information concerning what appears to represent the migration of bats out of Nova Scotia in autumn. Digby Neck, Long Island and Brier Island form a long narrow peninsula opposite the coast of Maine. It is known that many Nova Scotia birds funnel to the tip of this peninsula in late summer and gather in flocks on Brier Island where they apparently await favourable weather conditions before making the crossing to the United States mainland. This is fifty miles by the shortest route to the northwest or about eighty miles if they fly due west towards Bar Harbour. During September, groups of bats have landed and rested on boats fishing at night that are anywhere from seven to thirty miles to the west of Brier Island. Some bats enter the open cabins, as did a group of five in late September of 1959 where they stayed for an hour. Thus far it has been impossible to obtain specimens of these presumably migratory bats because the fishermen would not touch the creatures with a ten-foot gaff.

J. Sherman Bleakney

Biology Department
Acadia University
Wolfville, N.S.
28 September 1964

The Barn Swallow in the Central Canadian Arctic

On June 4, 1964, a single Barn Swallow, *Hirundo rustica* Linn., was seen in the Perry River region of the central Canadian Arctic, at the eastern extremity of the Mackenzie District, N.W.T.

A field party conducting a breeding study of Ross's Goose (*Chen rossii* Cassin) observed the bird at Arlone Lake (67° 22′N, 102° 10′W). The bird was first seen at 4:00 p.m., M.S.T. It stayed in the camp vicinity for approximately two hours. During this time it remained around our tent, usually perching on the supporting ropes on the leeward side, presumably to take advantage of the protective cover provided by this spot. Winds had been blowing constantly from the northwest since the morning of June 2, with a velocity of 40-45 m.p.h. with occasional gusts up to 50 m.p.h. It is possible that the bird was blown from its normal breeding range to this region.

Previous arctic records in Canada as indicated in the A.O.U. Check-list of North American Birds (1957, 5th Ed., p. 32) include only Victoria and Mansel islands. The breeding range in western North America extends north to north-central Alaska, southern Yukon, and western Mackenzie.

John P. Ryder

Department of Zoology
University of Alberta
Edmonton, Alberta
1 October 1964

An Erroneous Record of the Gray-cheeked Thrush in Saskatchewan

J. H. Fleming (1919, Canadian Field-Naturalist 33(6):109-113) has recorded the ornithological data and specimens secured in 1914 by Captain Angus Buchanan in northern parts of Saskatchewan and Manitoba. Fleming (*tom. cit.* :113) listed an alleged Gray-cheeked Thrush,

Hylocichla minima, taken on Churchill River, Saskatchewan, on June 18 with the comments that this specimen was in very worn plumage and was "in company with a mate". This record, which suggests breeding considerably outside the known breeding range of the species, continues to be cited by authors.

The specimen is in the Saskatchewan Museum of Natural History and through the courtesy of W. Harvey Beck, I have been able to examine it as well as Buchanan's original label. The bird is, as Fleming stated, worn and faded. It is not, however, a Grey-cheeked Thrush. It is unquestionably a Swainson's Thrush, *Hylocichla ustulata swainsoni.* There is, therefore, no evidence of the nesting of the Gray - cheeked Thrush on the Churchill River, Saskatchewan.

Definite records of the nesting of the Gray-cheeked Thrush in Saskatchewan seem to be lacking. However, Nero's (1963, Saskatchewan Natural History Society, Special Publication 5:111) sight records in July at Stony Rapids and Hasbala Lake suggest that it may breed in the extreme northern part.

W. EARL GODFREY

National Museum of Canada
Ottawa, Ontario
17 November 1964

New Distribution Records of Amphibians and Reptiles in Eastern Canada

SEVERAL COLLECTIONS of amphibians from Ontario and Quebec deposited in Carnegie Museum (CM) provide new distributional information and range extensions and include one species previously unreported in the fauna of Canada. The specimens from Vaudreuil County (April and May, 1960) and James Bay (August 1961) were collected by Durden. Our authority for current Canadian records is Logier and Toner's revised *Check List of the Amphibians and Reptiles of Canada and Alaska* (1961, Royal Ontario Museum Contributions 53: 92 pp.) and Bleakney's *A Zoogeographical Study of the Amphibians and Reptiles of Eastern Canada* (1958, National Museum Bulletin 155: 119 pp.).

Pseudotriton ruber ruber.—An adult female specimen (CM 39564, 62 mm snout-vent length, 107 mm total length) is from Dunchurch near Parry Sound, Parry Sound County, Ontario (D.C. Sands, September 7, 1946). It has the back well peppered with discrete spots, the chin darkened by a narrow row of black spots, and appears typical of *P. r. ruber* in all characters. This is the first record of *Pseudotriton* in Canada, and constitutes a range extension from southern New York and northern Pennsylvania, an airline distance of something over 200 miles.

Hemidactylium scutatum.—Two specimens from Ile Perrot, Vaudreuil County, Quebec (CM 39690-91) are from near the northern limit of the species range in Canada. These animals were collected under a hemlock log on the bank of a *Chamaedaphne* bog one mile west of Ile Perrot Station. After this manuscript was submitted for publication an additional specimen from Ile Perrot was reported by Denman (1965, Canadian Field-Naturalist 79(1): 77).

Hyla versicolor. — One specimen was taken from Ile Perrot (CM 39692). Although Logier and Toner (1961: 37) omitted records in the eastern townships of Quebec, several are plotted by Bleakney (1958: 88). Also collected on Ile Perrot were *Ambystoma laterale* (CM 39676-80), *Plethodon c. cinereus* (CM 39681-89), and *Hyla crucifer* (CM 39694).

Hyla crucifer.—A specimen taken in the James Bay lowland of northwestern Quebec (River Again, 50°51'N, 79°28'W) is a significant northern record. The adult male specimen (CM 39675, svl 29 mm.) is typical, and one of two individuals seen sitting on *Heracleum* plants in a river flood meadow at mid afternoon on August 4, 1961. Although the species has been reported from Labrador and far

northern Ontario (Logier and Toner, 1961: 34; Bleakney 1958: 87), substantiated localities in the northern periphery of its range are extremely scattered.

Also collected in the James Bay lowland in August, 1961 were *Ambystoma laterale*, *Plethodon cinereus*, *Bufo americanus copei*, *Rana septentrionalis*, *Rana pipiens*, *Rana palustris*, *Rana sylvatica*, and *Thamnophis sirtalis*, but the specimens were subsequently lost in transit. *Rana palustris* has been reported from James Bay on the basis of specimens collected by Drexler and listed by Cope (1889, U.S. National Museum Bulletin 34: 409). Logier and Toner (1961: 46) discussed this record and indicated that it requires verification, although Bleakney (1958: 13) felt it might be valid. Our observations lend weight to Cope's report, but confirmation of the occurrence of this species in the James Bay area must await receipt of preserved specimens.

C. J. McCoy
C. J. Durden

Carnegie Museum
Pittsburgh, Pa., and
Biology Department
Yale University
New Haven, Conn.
25 November 1964

Barbula eustegia, a Moss New to Canada

In his revision of the North American species of *Barbula* in Grout's *Moss Flora*, Steere reported *B. eustegia* Card. & Thér. from Washington, Idaho, Utah, and Montana. The species can now be reported from the Canadian side of the international boundary on the basis of three specimens from British Columbia filed in the National Herbarium of Canada as *Barbula convoluta* Hedw. John Macoun collected it "on a cutting by the railway" at Goldstream, Vancouver Island, on June 2, 1893. Apparently some of the same collection was distributed (without specific locality or habitat data) as *Barbula chrysopoda* C. M. & Kindb. in Macoun's *Canadian Mosses*, specimen no. 77, but erroneously so, inasmuch as *B. chrysopoda* is a synonym of *B. convoluta*. Wilfred B. Schofield also found the species on June 3, 1961 on a dry bank at Boot Cove, Saturna Island, Gulf of Georgia (collection no. 14352).

Barbula eustegia can be distinguished easily from *B. convoluta* by its longer, narrower leaves not ending in an apiculus and longer perichaetial leaves which are strongly sheathing at base and abruptly narrowed to a linear, papillose subula (whereas those of *B. convoluta* are rounded, rounded-obtuse, or even truncate). *B. eustegia* is a somewhat delicate version of the European *B. flavipes* BSG. On the basis of the few specimens available (from Austria and Bavaria), I believe that *B. flavipes* is distinct from the North American plants, even though the differences are mainly quantitative and geographic.

The illustrations of *B. eustegia* accompanying the original description (1900, Botanical Gazette 30: 23. Pl. 4.) and reproduced in Grout's *Moss Flora* are quite poor; the sketches of the synonymous *B. perannulata* Williams (1902, Bulletin of the New York Botanical Garden 2: 385. Pl. 36.) are much better.

Howard Crum

National Museum of Canada
Ottawa, Ontario
2 February 1965

Present address:
The Herbarium, North University Building
University of Michigan, Ann Arbor, Michigan

An Impressive Gray Jay Migration

On the afternoon of August 23, 1964, in a little over three hours, while anchored in Seal House Cove, Moisie Bay, on the North Shore of the Gulf St. Lawrence, I counted 755 Gray Jays, *Perisoreus canadensis*, crossing the Cove from east to west. This movement had been going on at the same pace during daylight from the time I arrived the day before about 4 PM until the time of departure the following morning around 10 AM.

From August 29 to September 13, I was along the coast east of Moisie River but always within 40 miles of it. The jays were ever present and continually moving in what seemed to be an unending ribbon, each flock of from 15 to 100 birds so close to the preceding one that it was difficult to separate one group from another. The same flight path was utilized by the bulk of the migrants.

I returned to the coast on October 12 to the same district and was there until October 21. The east to west passage was still on but the numbers were down to what I considered normal—between 100 and 200 per day. In my limited observations I came across many tufts of Gray Jay feathers indicating that a considerable number had been consumed by hawks.

In conversation with coastal residents I learned that the migration of the jays had been uninterrupted from mid August until well into October and was the most striking within memory. My personal experience dates back to 1945 and within that period I never observed anything approaching the magnitude of this movement.

My impression of this 1964 migration, as well as those happening every autumn, is that the jays follow the same general route which is a great circular path originating in northeastern Quebec and Labrador. The birds move south to the coast via the river valleys to the ocean and then strike westward and at some point in the westward flight change direction to the northwest and fly inland, perhaps finally circling back to where they came from. Perhaps one can conclude that westward penetration is dependent on the size of the migration—the greater the numbers involved, the farther west the birds move, a few stragglers eventually reaching the lower Ottawa River valley.

J. MITCHELL CAMPBELL

The Moisie Salmon Club, Inc.,
P.O. Box 788
Seven Islands, P.Q.
22 December 1964

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Articles

Reviews

Notes

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ALICE EVELYN WILSON
1881 - 1964

LORIS S. RUSSELL
Chief Biologist, Royal Ontario Museum, University of Toronto, Toronto, Ontario

ALICE EVELYN WILSON WAS a gentle, quiet-spoken lady, who came of a prominent family in the Cobourg district. But she was of strong character, a person who could decide on her course and carry out the decision, in spite of obstacles and discouragement. It was in 1900, at the age of 19, that she decided to be a geologist. The Victorian era was drawing to a close, but its attitude towards women who sought a career outside the home was still that of fowning disapproval. And geology, of all things; why, my dear, you would have to go out on field work with men! But Alice found employment with the Geological Survey of Canada in Ottawa, and was able to attend the University of Toronto and graduate with her B.A. in 1911.

Back at Ottawa she had the impressive title of Museum Assistant. The Geological Survey had just moved into the new Victoria Memorial Museum and there was much to do in shifting, arranging and labelling the collections. These tasks were carried out consciencìously, but a geologist's laboratory is the out-of-doors, and in Ottawa this was the superb Ordovician section that had been made famous by Billings and Raymond and Ami. Unravelling the details of this 400 million year old record was to be her life's work.

Came 1914 and the first World War. The programme of the Geological Survey slowed down. In February, 1916, the Centre Block of the Parliament Buildings burned, and the Victoria Memorial Museum was requisitioned to house the war-time Parliament. It was Alice Wilson who worked round the clock, supervising the meticulous packing of the exhibition and study collections. Then she sought war service in the Canadian equivalent of the Women's Land Army.

In 1920, with the war over, and the Survey back in the Museum building, Alice was now an Assistant Palaeontologist. Her chief was Dr. E. M. Kindle, a great student of fossils and a pioneer in the study of sedimentary processes. It was he who persuaded her that there was little future for a B.A. in professional science, so off she went to the University of Chicago, to take her Ph.D. under the great Stuart Weller. Ted Link, one of our most distinguished oil geologists, was a class-mate of hers in the graduate school, and he tells how she introduced the custom of afternoon tea. When she left, in 1929, Americanism asserted itself and the institution became afternoon coffee, a custom that still persists, I'm told. In addition to the doctorate, she came away with membership in the distinguished scientific fraternity of Sigma Xi.

Mailing date of this number: December 29, 1965

Alice Evelyn Wilson, June 6, 1939.

—photograph by Karsh, Ottawa.

Back in Ottawa, full of enthusiasm for great projects in Ordovician palaeontology and stratigraphy, she landed into the middle of the depression. Scientific research, except for the most utilitarian, again starved of support. But the advantage of having a research field in your front yard is that it doesn't cost much to work it; in fact you can do it on your own. And so the carefully documented collections, the meticulously recorded observations, the minutely sketched field maps, continued to accumulate. Not much of it had appeared in print, but people knew what was going on. So it was that in 1933, when the Bennett Government briefly re-introduced the Honours List for Canadians, Alice Wilson became a Member of the Order of the British Empire.

The years of careful study soon began to bear fruit, and a series of monographs on the fossils and the stratigraphy of the Ordovician rocks in the Ottawa and St. Lawrence valleys appeared as Memoirs and Bulletins of the Geological Survey. Recognition by her peers came in 1938 with her election as a Fellow of the Royal Society of Canada, the first time that this distinction had been given to a woman. From Assistant Geologist she was promoted to Associate Geologist and finally to Geologist, at which rank she retired in 1946.

Retired? No such thing! The monographs continued to flow, but to this impressive output were added a teaching programme at Carleton University, and increased activity in the popularization of Geology. All sorts of groups were given the grand tour: school children, university students, the Ottawa Field-Naturalists' Club, and professional geologists. Fortunately she was persuaded to put down some of this lore, and her Guide to the Geology of the Ottawa District, published as Volume 70, No. 1 of the Canadian Field-Naturalist, will long be the standard reference for those who want to see the Ottawa section first-hand. And then there were trips abroad. One winter she and a companion travelled to Brazil by freighter and visited the Amazon jungle. At the International Geological Congress of 1956 in Mexico she took part in the excursions, and the sight of this dignified and seemingly frail lady geologist from Canada, in field clothes and riding a burro, was something to shake our Mexican colleagues.

To the last it was the unsolved problem that interested her most. For some time she was working on a paper that would set forth the needs for further studies in the Ottawa-St. Lawrence region. Whether she finished it or not I never learned. But I am sure that at the end her concern was for the fossils that remained to be identified, the faunal zones yet to be delimited, the correlations still to be refined, and the broad structural features that needed to be explained.

The name Wilson is an honourable one, both on the Geological Survey of Canada, and in the membership of the Ottawa Field-Naturalists' Club. Because of her many contributions to geological sciences, her ability and willingness to pass on her findings at any level of learning and her devotion to and enthusiasm for the search for truth, Alice Evelyn Wilson was a worthy member of this distinguished group.

HOME AREA AND COMPARATIVE BIOMASS OF THE NORTH AMERICAN RED SQUIRREL*

Carl O. Mohr
Division of Parasitology, University of California, Berkeley

The North American red squirrel, *Tamiasciurus hudsonsicus loquax*, is particularly satisfactory as subject for study of biomass and home range of primarily seed-eating mammals; it is diurnal, usually conspicuous, excitable, and often loquacious when its presence might otherwise be unnoticed. Its home area and territory therein are easily identified by its calls, behavior, and reactions toward neighbors.

With the exception of a study by Layne (1954), previous studies of populations of the red squirrel have been based on general, though probably good impressions, and calculated areas of home ranges have been based on the minimum home-range method usually using 100 percent of the observations for each squirrel. It is now possible to re-evaluate both home area and biomass for the red squirrel by other methods, based on direct observation of marked individuals by Dr. James N. Layne on the campus of Cornell University. He has kindly made his field data available for interpretation.

Habitats and Procedure

The red squirrels on the campus were studied by live-trapping, marking, and subsequent direct observation during June, July and August 1952 and 1953 in a 50-acre park-woods habitat. Places at which the marked squirrels were seen subsequently were recorded on maps of the campus. About 28 acres (11.2 hectares) were encompassed by home ranges of the squirrels. The remainder of the campus was unused by red squirrels because it was occupied by buildings or had too few trees. To evaluate the intensity of use of that part encompassed by home ranges of squirrels, the map was divided into squares or plots of 100 feet per side. This area was chosen because it is extensive enough (about 0.23 acre) to contain a considerable percentage of any single red squirrel's home range and because the presence in such an area of three or more trees with a diameter of forty feet between drip lines of the leafy crown makes the area inhabitable or at least usable for travel.

Most of the treeless area lay at the periphery of the campus, isolating it considerably from overlap by home ranges of squirrels living beyond the campus. (The areas occupied by buildings are regarded as habitat blanks because no squirrels were observed using the buildings and because trees, from which squirrels garnered most of their food, probably did not draw measurable nourishment therefrom). There were 325 trees of at least 6 inches diameter at breast height on the area. Fifty one per cent were American elms, *Ulmus americanus*, and the remainder were mostly other hardwood species with a few conifers. During 1952 the crop of elm seeds was good, but during 1953 it

*This investigation was supported in part by a research grant (AI-03653-05) from the National Institutes of Health, Division of Research Grants, Public Health Service.

FIGURE 1. Stars of two types represent points at which two squirrels, A and B, were observed in their home ranges. B + A represents the composite range made by matching median centers and axes, with short segments of axes matched to short; long to long. Lines represent the axes.

was poor, apparently with considerable effect on the home ranges of the squirrels.

A few squirrels were studied in a hemlock, *Tsuga canadensis*, grove by means of trapping and retrapping. Data from these are included for limited comparative value. Layne felt that the home ranges were not perceptibly affected by his trapping because the traps were set at irregular intervals. Chitty's experience (1937) indicates that this is so.

Blair (1951:31) and Howard (1949:21) have provided searching comparisons of home areas calculated from trap-retrap records and those based on direct observation. There are some differences and some strong resemblances depending on the trapping technique used.

Shapes of home ranges are interpreted after the composite home-range method (Mohr and Stumpf, 1964). This was done by: (1) drawing a straight line (the long axis) on individual home-range maps through the greatest possible number of marks representing points at which the squirrels were seen, in such a way as to divide the mass of points into two equal groups, of which the sums of distances from the axis were as small as possible, then (2) drawing a cross line (the short axis) perpendicular to the long axis, to divide the field of marks into two equal lots in the other direction (Figure 1 A and B). Having thus determined the median-center and the long and short axes of each home range, the sub-median centers and lengths of each half of each group of marks were determined by dividing these marks into equal halves. Then composite maps were made by fitting primary centers and long and short segments of axes over one another on a common map. In many cases the home ranges were approximate mirror images of one another. In such cases two sets of composite maps were made: one for what may be called dextral ranges (Figure 1A) and the other for sinistral ranges (Figure 1B). These were eventually combined by turning one set over the other to make a master composite map for the age, sex, or habitat condition desired (Figure 1 B + A). For convenience here, this is referred to as the composite range method. After ranges were so

matched, the sizes and shapes of the polygons within which 50, 67, and 90 per cent of the points at which animals were observed nearest the median axes were used in determining various areas of the home ranges. These include, successively, the core of the ranges, and most of the observations without including some of the temporary visits by the squirrels to out-lying areas but without rejecting the outlying points completely. Results are compared with those from the minimum home-range method. Frequency-distributions of observed activity (Figure 2) were determined for further interpretation of the areas of activity.

Thanks go to Drs. Lowell Adams, J. R. Layne, O. P. Pearson, G. C. Sanderson and to Mr. W. A. Stumpf for valuable discussions and other assistance.

OBSERVATIONS

Eight adult males, five adult females, and sixteen juveniles occupied the 10.4 hectare (25.7 acres) area during the summer of 1952. Eight adult males, six adult females and twenty-six juveniles occupied it during 1953. Only records for individuals for which there were at least five observations were used for calculation of area of the home ranges. All individual records were used for calculation of biomass.

During both 1952 and 1953, chipmunks (*Tamias striatus*) were about as numerous as the red squirrels, and gray squirrels (*Sciurus carolinensis*) were about half as numerous (Layne, 1954). The gray squirrels used interspaces on the campus not used by the red squirrels and the chipmunks were more restricted to the shrubby areas. Since chipmunks and gray squirrels compete for food with the red squirrels and since gray squirrels probably also compete for nesting sites, the competing biomass (chipmunks and gray squirrels) amounted to approximately 376 gms. per hectare during 1952 and 403 gms. during 1953.

Shapes of Home Ranges of Adults: During 1952, four adult male red squirrels maintained average home ranges in which the distribution of each, 50, 67, and 90 per cent of the points from center were within relatively narrow areas. The area which included 50 per cent of the points was 2.8 times as wide as long and was 481 feet long; that which included 67 per cent of the points was 703 feet long and 1 x 2.4, and that which included 90 per cent of the points was 949 feet long and 1 x 1.6.

Adult females also maintained relatively narrow ranges during 1952: 400, 450, and 575 feet long respectively and 1 x 2.4, 1 x 2.2 and 1 x 1.5 in proportion.

One of these females which was observed 39 times during 38 days from June 22 maintained a range of which 50 per cent of the points were within an area which was 1 x 3.6, and 373 feet long. Sixty-seven per cent were within an area 1 x 3, and 90 per cent within an area of 1 x 4.2 units.

During 1953 the ranges of adults of both sexes were both broader and longer. Four adult males maintained ranges in which 67 per cent of the points lay in areas 950 feet long and 1 x 1.5. Four adult females maintained ranges 538 feet long and 1 x 1.5. The area of 90 per cent of the points was correspondingly longer and elongate.

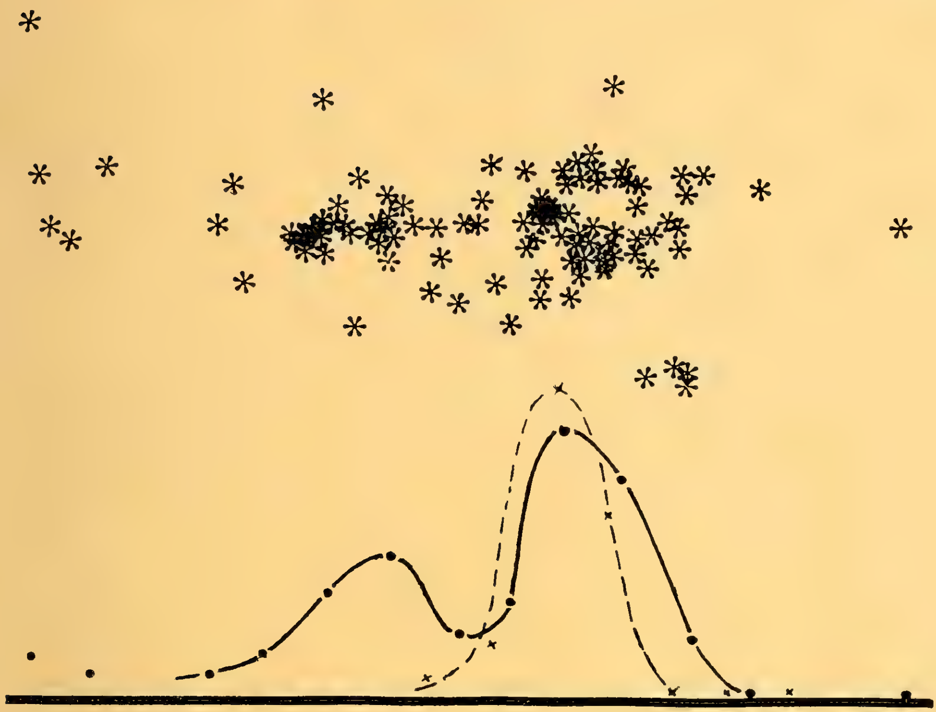

FIGURE 2. Composite home range (top); and profile (solid line) and end view (broken line) of frequency distribution based on the composite range of adult squirrels on the campus during 1952.

In all cases the median center was well toward one end of the long axis, somewhat as in Figure 1. Blair (1951:31) gives reasons for calculating centers of observed activity for each meaningful period as activities shift with season and functions.

Comparision of Composite-range and Polygonal Method: During 1952, 50 per cent of the 48 observed points in the composite range of male red squirrels lay within 1.9 acres; 67 per cent were within 4.1 acres; and 90 per cent were within 7.5 acres (Table I). During 1953, 67 per cent of the points were within 7.5 acres and 90 per cent in 14 acres.

The acreage (4.1) encompassing 67 per cent of the points during 1952 is slightly smaller than that (4.4) calculated by Layne using the individual minimum home-range or polygonal method which is based on 100 per cent of the points. The acreage (7.5) for 1953 based on 67 per cent of the points is considerably less than that (9.4) based on the polygonal method.

Females maintained smaller areas. During 1952, 67 per cent of the points for males lay within an average area of about 1.4 as large and during 1952 in an area about 2.9 times as large. Ninety per cent in 1953 were within an area which was 2.9 times as large as that of the preceding year.

TABLE 1. — Areas of Home Ranges (Acres) of Red Squirrels on Campus Calculated by Two Procedures

Adults	Year	Method		
		Composite		Polygonal
		67%	90%	100%
4	1952	4.1	7.5	4.4
2	1953	7.5	14	9.4
6	1952–3	5.0	9.7	6.03±1.51
3	1952	1.4	4.1	2.6
4	1953	3.4	10	6.3
7	1952–3	2.7	8.0	4.72±1.48

Acreages for females based on 67 per cent of the points were smaller than those based on the minimum home-range method (Layne, p. 257). Ninety per cent of the points usually lay in areas larger than 100 per cent in the polygonal method (Table I).

Male ranges tended to extend over those of three or four females. Whether or not this was induced primarily by some habitat factor, the social result was that the length of male ranges permitted them to cover all or part of the ranges of two or more females.

Aside from transitory changes in shape of the peripheral area (between 67 and 100 per cent of the range) in the direction of temporary new sources of food, and one complete shift of range of one female, no notable change of range was apparent for adults during a single season. Layne (p. 236) found individuals at the very extremeties of their known ranges, within a few minutes, indicating complete daily familiarity and use.

Shapes of Home Ranges of Juveniles: Juvenile red squirrels which remained on the park-like campus beyond July 15 in 1952 maintained home ranges which were 289 feet long and 1 x 2.9. Those which disappeared from the area before July 15 were observed over an average home range of 595 feet, and 1 unit wide x 1.9 long. During 1953 there was less difference in the two groups but those which remained longest maintained an average range of 645 feet and 1 x 2.4 whereas those which disappeared early occupied an area of 685 feet and 1 x 2.2.

The ranges of adults during 1953 were larger and longer than those of 1952, and both sets of juveniles had longer ranges during 1953 than during 1952.

Home Ranges in Hemlock Grove: Home ranges of six squirrels which were observed in an 10.3 acre hemlock grove by live-trapping from January 1951 through August 1952 also were narrow. One adult male observed five times during 15 months, remained within a maximum straight-line distance of 338 feet. Another observed over a period of almost 14 months remained within

FIGURE 3. Composite home range for squirrels in hemlock grove. The circle represents the median center.

a maximum distance of 295 feet long. The range of a third was nearly circular, based however, on only four points observed. Ranges of two females were also elongate; the 67 per cent area was 520 feet long and 1 unit wide by 4.7 units long. There was no marked change in length of the areas of these ranges during the long period of observation. The composite range (Figure 3) of these averaged narrower, shorter and considerably smaller than those of adults on the park-like campus even during 1952 when the observed ranges on the campus were smallest. The 67 per cent area was four times as long as wide.

Comparative Biomass: Since adult red squirrels weigh about 196 gms (Layne, 1954: 252) during midsummer, the biomass of 13 adults on 11.2 hectares of campus was 227 gms per hectare during 1952. That of 16 juveniles, weighing about 170 gms was about 243 gms per hectare during 1952 and the total was 470 gms per hectare. During 1953, biomass was 245 gms for adults, 395 for juveniles and totalled 640 per hectare.

When only 10.4 hectares are considered as being in use at the time, after subtracting the blanks *within* the total area encompassed by home ranges, the biomass becomes 245 for adults during 1952, and 264 during 1953. The biomass for young and old is 507 and 611 per hectare.

In the hemlock grove, adult red-squirrel biomass amounted to approximately 158 gms per hectare of area observed to be in use. This may be less than the actual biomass since the livetrapping-retrap method usually fails to catch some individuals.

DISCUSSION

According to Layne (1954:259), the home ranges of both sexes of red squirrels overlap broadly during and immediately following the breeding season. He (p. 261) reported, for example that he frequently observed more than two squirrels occupying the same nest (p. 247) and occasionally observed mating chases composed of as many as seven squirrels. Instance construed to represent defense of territory were relatively infrequent and confined to small areas. In most cases, reactions interpreted as expression of territorialism were limited to a harsh anger note or a short offensive lunge when another squirrel approach-

ed too closely, often within a foot, of a feeding individual. Occasional altercations occurred between two or three squirrels over nest cavities (p. 260).

Red squirrel territories thus appear to be small, dispersed in the home range, somewhat elementary, and to consist of places which are used regularly as nests and food caches, or which are occupied only at the moment (if the latter can be regarded as incipient territorialism).

The red squirrel therefore seems to fit best in an intermediate category in Davis' system (1949) in which territory consists of narrow surroundings of the nest as in "A" and the immediate surroundings of the feeding area or caches of food as in "C", but not incorporating the mating area. Red squirrel territories are then diffused rather widely in the home range. Later however, when the squirrels store food for winter, aggressiveness and territorial isolation may be considerably greater (Cahalane, 1947:389), and the red squirrel's home range may change into a well defined territory incorporating nesting and feeding area. (Kilham 1954). The type would then fall into Davis' category "E". Males and/or females may maintain each kind.

Shapes of Home Areas: Data (from Layne), hence objectives in analyzing shape of range, are limited to day-time use of home areas over a period of a few post-breeding months. Therefore the amount of time individuals spend on a given spot is not considered except in so far as they are likely to be seen most often in the places in which they spent most time when active during the periods of observation. (Probably they spend more time in beds or nests than elsewhere in their home areas).

The shapes and areas of the home ranges fall into a gradient, being smaller and narrower during the better year in the parkwoods habitat, and both shortest and narrowest in the best habitat, a hemlock grove, though in the latter case, the method of taking the squirrels (trapping and retrapping) may have restricted the size of home range and possibly its shape.

Undoubtedly the linear distribution of desiderata in the average animal's environment tends to produce a linear home range as indicated by Harrison (1958:191) for Malayan rodents which he observed by trapping and retrapping. However, sexual and competetive sociology do also as indicated below.

Perhaps the earliest study of territory (Elton, 1932) was of a highly developed one: for colonies of wood ants, *Formica rufa*, which act as a territorial entity. The colonies maintained linear "food territories" and extensions of any colony were pushed between the bordering colonies, inducing linearity in the process. Male pheasants, *Phasianus colchicus* according to Taber (1949: Figure 1) and hippopotamus, *Hippotamus amphibius*, according to Hediger as reviewed by Bourlière (1956:106), also appear to achieve linearity by similar processes. On the other hand, howler monkeys, *Alouatta palliatia*, which maintain a patriarchial organization consisting of an adult male, several adult females, and young individuals (Carpenter, 1934) differ from red squirrels in being uniterritorial in that all essential activity is incorporated into a compact territory.

Since adult males and females move about the territory together they can maintain fairly circular territory. One band which occupied poor habitat maintained a large slightly skewed territory, tending to be elongate but another,

in good habitat, maintained a smaller and nearly circular territory. Other examples of both linear types and nearly circular types of territory are reported by Stumpf and Mohr (1962) and Mohr and Stumpf (1962).

It seems probable that polygamous species in which males and females maintain separate home ranges or territories would have real difficulty in maintaining circular ranges; the male (and possibly female) would have to shape its range to visit one or more of the opposite sex. Elongation probably is then inevitable.

In the red squirrel, which is polygamous and relatively tolerant of neighbors at the time of year observed, the elongate bimodal appearance of the home range profile (Figure 2) suggests that the location of a nesting hole with reference to some other attraction, perhaps food stores, induces linearity between breeding seasons.

Comparative Biomass: The minimum biomass of tree squirrels reported by Odum and Odum (1950:152) is greater than that of smaller seed eaters such as mice in the same trophic group. In general the members in each of the major trophic groups below seed eaters (carnivores, omnivores and herbivora) attain an increasingly larger biomass per unit area than do members of the preceding groups. The larger species within each group attain greater biomass than do the smaller members.

Since adult red squirrels maintained 37 to 48-day midsummer postbreeding biomasses of from 245 to 264 gms. per hectare on the 10.4 acre section of the campus and since young and old maintained a biomass of from 507 gms. in 1952 to 611 gms. during 1953, their mass is considerably less than the minimum (1.2 kg) indicated by Odum and Odum for tree squirrels in general. The total sciurid biomass, when young are leaving nests and parental territories, based on the weights of red squirrels, gray squirrels and chipmunks on the campus (883 gms. for 1952 and 1014 gms. for 1953) also is short of the minimum reported by Odum and Odum and considerably less, than their maximum, and that (2.3) cited by Cockrum (1962:155). These maximums include biomasses of such large squirrels as *Sciurus niger*, about four times larger.

It is tempting to speculate concerning the reason for the lower observed biomass of red squirrels. They appear to be more nervous than the larger squirrels, and their metabolic rate undoubtedly is higher, making for less efficient use of sustenance; this is a common characteristic of small versus large animals. Unless some adaptation permits the red squirrels to overcome the size handicap, one would expect a lesser biomass from them than from the larger squirrels. However, observational errors must be overcome and differences in habitat must be measured before closer analysis can be made. Most extant population and home-range studies do not easily permit comparison since the methods differ widely.

SUMMARY

Comparative biomass, territory and home area and shape are calculated for the North American red squirrel from data provided by Dr. James N. Layne who published (1954) on other aspects of the biology of this animal. Whether

the data are treated as by Stumpf and Mohr (1962) or as herein, they indicate relatively narrow home ranges. The method used here gives a more compact central area.

Home ranges of adult squirrels tended to be distinctly linear during the period of observation: parts of June, all of July and part of August. Linearity was related positively to the quality of the habitat though, directly or indirectly, also to annual sexual and competetive sociology.

The composite method of determining home area results in larger averages than does the widely used minimum home range (convex polygonal) method when the composite method is based on 90 percent and the polygonal method is based on 100 percent of the observed points. When based on 67 of the observed points, the composite average is smaller, more compact, and averages about 72 percent of the area indicated by the widely used polygonal method.

The tendency toward territoriality by red squirrels appears to be primitive immediately after the breeding season, recognizeable territories being small and scattered within the home range. Writers indicate that the territories may encompass more of the home range and become better defined during the food garnering and guarding season in fall and winter.

This study was prompted, in part, by the desire to find an alternative method to the one based on the circular concept of home range (or territory) for calculating the area over which animals move and in which they come into contact with parasites or other objects spread more or less at random therein. The composite range method appears to be suitable for use where certain ticks and chiggers are concerned, and, since flying parasites such as mosquitoes, can overcome some of the blanks within home ranges of these potential hosts, this method appears to be better for them.

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CANNIBALISM IN STARVING WOLVERINES AND SEX IDENTIFICATION FROM SKULLS

DONALD R. FLOOK and JAMES RIMMER
Canadian Wildlife Service, Edmonton, Alberta, and Park Warden Service, Banff National Park, Banff, Alberta

ON MAY 26, 1963, the intact carcass of a female wolverine, *Gulo gulo*, was found along with hair and pieces of bone including the mandibulae and maxillary and premaxillary parts of the skulls of four other wolverines and two martens, *Martes americana*, in a dry wooden water tank near Lake Louise Junction, Banff National Park, Alberta.

The tank is about eight feet high and eight feet in diameter, open at the top and sitting on the ground in a forest of Englemann spruce and alpine fir. It had been drained the previous autumn. Apparently the animals had entered it sometime during the winter either by jumping from a tree, the closest of which was about 40 inches from the tank, or else by travelling along a horizontal pipe running to the top of the tank.

Efforts at escape by the wolverines were evidenced by claw marks around the inside of the wall of the tank about six feet above the floor which in winter would have carried a substantial thickness of snow. An abundance of wolverine feces containing bone fragments and hair of wolverines was scattered over the floor of the tank.

The female wolverine found intact apparently died of starvation, as no subcutaneous or visceral fat was in evidence, the stomach was empty, and there was no evidence of other cause of death. The mammae and uteri were in quiescent state.

A group of three young wolverines seen in the area on August 12, 1962 may have been included among those in the tank. One can only speculate

TABLE 1. — Skull and dental measurements (in mm) of wolverines of known sex

		(1) Length of maxillary tooth row	(2) Antero-postero diameter of maxillary canine	(3) Length of mandibular tooth row	(4) Antero-postero diameter of mandibular canine	(5) Greatest length of skull
9 females	Mean	47.1	10.1	57.4	10.1	140.9
	Range	45.6–49.7	9.5–10.8	55.0–60.5	9.4–10.6	132.3–148.0
	Standard deviation	1.469	.418	1.755	.447	4.000
13 males	Mean	50.9	11.6	62.8	11.6	159.9
	Range	47.5–52.7	10.7–12.6	59.8–65.5	11.1–12.2	150.8–166.7
	Standard deviation	1.369	.562	1.830	.353	5.000
Comparison						
	Mean difference	3.8	1.5	5.4	1.5	19.0
	Student's "t" value	6.133**	6.793**	6.974**	8.412**	9.697**

(1) (3) Distance from anterior edge of canine alveolus to posterior edge of last molar alveolus.
(2) (4) Canine measured at ridge which circles tooth at gum line.
(5) Distance from anterior point of premaxilla to posterior tip of supraoccipital.
** Significant at 1 per cent.

as to the circumstances and sequence of the entries of the animals to the tank, their deaths and consumption. One or more of the wolverines probably followed the martens into the tank to prey or scavenge upon them. In any case a female outlived and devoured the last of the other members of the wolverine group which, based on evidence to follow, is thought to have consisted of three females and one male.

Wright and Rausch (1955) studied the relationship of cranial measurements to sexual maturity in wolverines. They found that the animals had permanent dentition by October 1, in their first year of life. After that, although immatures tended to have smaller cranial measurements than adults, there were individual cases of overlap between those age classes within the same sex. Cranial measurements of the female found intact in the tank correspond most closely to the mean values for immature females presented by Wright and Rausch.

Wright and Rausch showed sex differences between mean measurements, the most marked being in the greatest length of skull. However, as ranges and standard deviations were not shown, it was not possible to ascertain whether sex could be identified from those measurements. In the current work, measurements were sought which would permit sex identification of the animals of which only bone fragments were found. Such criteria would also be of value for another purpose. Wolverine carcasses salvaged from predator poison stations on non-park lands can provide useful study material. As the genital organs are frequently destroyed by scavengers, a method of sex identification from skeletal material would be useful.

Measurements were taken from the skulls and mandibulae of 13 male and 9 female wolverines collected in the Northwest Territories, Yukon, and

TABLE 2. — Measurements* (in mm) of bone fragments from tank to identify their sexes

(1) Length of maxillary tooth row	Sex identific-ation	(2) Antero-postero diameter of maxillary canine	Sex identific-ation	(3) Length of mandibular tooth row	Sex identific-ation	(4) Antero-postero diameter of mandibular canine	Sex identific-ation
51.6	♂	11.2	♂	64.0	♂	11.8	♂
45.7	♀	9.5	♀	54.1	♀	10.0	♀
46.0	♀	9.5	♀	55.7	♀	10.0	♀
—	—	9.8	♀	57.0	♀	10.2	♀
Total males	1		1		1		1
Total females	2		3		3		3

*Maxillary and mandibular measurements on same line are not necessarily from same specimen.

Alberta and assembled in the Zoology Departments of the Universities of Alberta and British Columbia. All the specimens had complete permanent dentition. The measurements are summarized in Table 1. The differences between males and females in each of five measurements were significant at the one per cent level of probability. Although there were a few instances of overlap between sexes in three of those measurements: (1), (2), and (3), the ranges of values for males and females were discrete in the cases of two measurements; antero-postero diameter of mandibular canine (4), and greatest length of skull (5). It thus appears that by using either of those criteria alone or with the support of any of the other measurements described, the sex of wolverine with permanent dentition can be identified from skulls with reasonable confidence.

The measurements of the dental fragments from the tank are presented in Table 2. There, it is observed that one set of measurements lies within the range for males given in Table 1, and the remaining three sets of measurements lie within the female range.

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NOTES ON THE MORE RECENTLY ADVENTIVE FLORA OF THE BRANDON AREA, MANITOBA

George A. Stevenson
Canada Department of Agriculture, Experimental Farm, Brandon, Manitoba

The thirty-nine species of vascular plants reported in this paper were collected in the vicinity of Brandon, Manitoba, between 1947 and 1963. At the time of collection almost all were new records for Manitoba, some were new records for Canada, and at least five, *Eremopoa persica*, *Ribes dicanthum*, *Cotoneaster melanocarpa*, *Astragulus cicer* and *Melilotus wolgica*, were new for North America.

Collections were made within a four-mile radius of Brandon. The different sites on which these species were first collected were visited again in 1963 and 1964 to observe which had persisted.

Duplicate specimens of all collections have been deposited in the herbarium of the Plant Research Institute (DAO), Ottawa, and in the herbarium of the Experimental Farm, Brandon, Manitoba. Numbers in italics are the author's collection numbers.

Alopecurus myosuroides Huds. — Slender Foxtail. Stevenson (1957b). Collected in 1955, *933*, in cropland where it was introduced, probably with seed of other grasses. It did not persist. The only other Canadian record is from Saanichton, B.C.

A. pratensis L. — Meadow Foxtail. Scoggan (1957). Collected in waste grassland in 1950, *149*, and again in 1963 in the same general location. Collected in a drainage ditch between Lake Percy and the Assiniboine river in 1960.

Bromus japonicus Thumb. — Japanese Chess. Collected in cropland in 1955, *954*. It persisted for a few years and then disappeared. Collected at a different location in 1964, *3249*, on disturbed soil in native pasture just west of the Experimental Farm. It is not common locally. Otterburne and Treesbank are the only other Manitoba records.

B. tectorum L. — Downy Brome. Collected on a cultivated roadway close to a nursery of *B. inermis* on the experimental Farm, Brandon, in 1955, *959*. It did not persist. The only other Manitoba collection is from Emerson.

Eragrostis megastachya (Koel.) Link. — Stink-grass. Stevenson (1957b). Collected in wasteland in 1950, *283*. It is persisting but not spreading to any great extent. Collected within the city of Brandon at several different locations between 1950 and 1964.

Eremopoa persica (Trin.) Rosh. — Persian Eremopoa. Stevenson (1957a). This weedy annual grass from Central Asia was first collected in the C.N.R. freight yards, Brandon, *945*. It has been kept under control by hoeing every year about the middle of June. Numerous scattered plants may be found over a fairly large area near the original site.

Lolium persicum Boiss. & Hohen. — Persian Darnel. Collected on a spur track close to a grain elevator in 1957, *1353*. It appears to be rare locally.

L. rigidum Gaud. (*L. subulatum* Vis.) — Wimmera Ryegrass. Collected in 1952 in a stand of sweet clover grown from seed imported from Victoria, N.S.W., Australia, *643*, *644*. It did not persist.

Digitaria sanguinalis (L.) Scop. — Crabgrass. Collected in 1957, *1403*, in a plot of

Melilotus suaveolens 'Golden Annual'. It did not persist at the original site but it was collected, *3130*, again in 1963, growing up through a broken sidewalk in Brandon.

Setaria glauca (L.) Beauv. — YELLOW FOXTAIL. Collected in cropland in 1952, *642*, and scattered plants were found in the same general area in 1964, *2167*. It appears to be rare locally. The only other substantiated record in Manitoba is from Morden.

S. verticillata (L.) Beauv. — BRISTLE FOXTAIL. Stevenson (1957b). Collected in 1949, 94, close to the horticultural green house on the Experimental Farm. Later it spread to the forage crops experimental plot area where it persisted for a few years and then disappeared. It is persisting at the original site despite repeated attempts to eradicate it. It was collected in 1957, *1381*, on a spur track in the C.P.R. freight yards, Brandon.

Reseda alba L. — WHITE CUT-LEAVED MIGNONETTE. Collected, *476*, on wasteland in 1951. It has not been seen since.

Berberis vulgaris L. — COMMON BARBERRY. Occasional plants have been observed or collected in woodland between 1953 and 1964, *781, 3003*.

Ribes diacanthum Pallas — Occasional plants have been observed in woodland surrounding the Experimental Farm. First seen in 1947 but not collected until 1956 and 1959, *1247, 1657*. It is new to North America. Unfortunately it was not possible to conduct a thorough search of the area in 1964 to ascertain its persistence.

Cotoneaster acutifolia Turcz. — First noted in 1947 in woodland but not collected until 1959. There were a few plants in the same general area in 1964, *1666*. It has been collected at Fort Garry and Pointe-du-Bois (B. Boivin, private communication).

C. melanocarpa Lodd. — First seen in 1947 in woodland but not collected until 1959, *1667*. It is new to North America. There were a few plants in the same general area in 1964.

Pyrus malus L. — CRABAPPLE. First noted in 1947, *1234*, *1960*, and is now common in ravines and woodland surrounding the Experimental Farm.

Astragalus cicer L. — CICER MILK-VETCH. Collected in a field of red clover in 1958, *1492*. No plants have been seen since the red clover was plowed-up in 1959. It is new to North America. There is an unreported collection from Stanley, Alberta. in the herbarium of the Plant Research Institute (DAO) Ottawa (B. Boivin, private communication).

Coronilla varia L. — CROWN-VETCH. Collected in 1956, *1145, 1750*. It has been a persistent and sometimes troublesome weed in the forage plot area of the Experimental Farm since about 1950. It is difficult to eradicate, especially on the lighter soils. It was reported from Ontario in 1957 and is known to be in Quebec. (B. Boivin, private communication).

Lotus corniculatus L. — BIRDSFOOT TREFOIL. Collected in 1954, *929, 2132*. It persists as an occasional weed in wasteland and cropland.

Melilotus wolgica Poir. — VOLGA SWEET-CLOVER. This species appears to be escaping from cultivation locally. It has been observed or collected in wasteland every year since 1960. It was noted at five different sites, one of which was within the city of Brandon, in 1963. This is a tall (up to about 1.8 m), hardy, white-flowered, biennial species of sweet clover which can be distinguished from the common white sweet clover, *M. alba*, by its small (3 mm) flowers borne on slender pedicels which are usually 3-4 mm long, or about the same length as the flowers. Both calyx and pedicels are usually tinged brick red. When in full bloom the plants have a dainty, lace-like appearance which reminds one of the common garden flower Baby's Breath, *Gypsophila paniculata*. It is apparently new to North America, *1962, 3004*. It has been observed in the forage plot area of the Research Station, Saskatoon, Sask.

M. indica (L.) All. — INDIAN SWEET-CLOVER. This annual was collected, *2168*, in the forage crop test plots at the Experimental Farm in 1960. It has been an occasional weed in the forage plot area since about 1955.

Vicia villosa Roth — HAIRY VETCH. *741*. Collected in grassland in 1958. It did not persist. This is the only Manitoba record.

Geranium pusillum L. — SMALL-FLOWERED CRANESBILL. Scoggan (1957). Collected, *788*, in 1953 in cropland where it was introduced, probably in nursery stock. No plants have been seen since 1954.

Abutilon theophrasti Medic. — VELVET-LEAF. Stevenson (1963). Collected, *2812*, in 1962 in a flower garden in Brandon. No plants have been seen since. It is the only Manitoba record.

Rhamnus frangula L. — ALDER BUCKTHORN. Collected in a ravine in 1958, *1557*. It is persisting.

Viola tricolor L. — JOHNNY-JUMP-UP. Collected, *3022*, in 1957 and is persisting as a weed in cropland.

Borago officinalis L. — This species was collected in 1953 and in 1954 on the site of the old bee nursery at the Experimental Farm, Brandon, *607*, *787*. No plants have been seen since.

Echium plantagineum L. (*E. lycopsis* L.) — PURPLE VIPER'S BUGLOSS. Collected in wasteland in 1953. It did not persist. This is the only substantiated Canadian record.

Myosotus arvensis (L.) Hill — FORGET-ME-NOT. Collected in 1953, *785*, 1955, and 1964 in wet, shaded soil at the bottom of a wooded ravine.

Symphytum asperum Lepechin — PRICKLY COMFREY. Collected in 1952 and is persisting in waste grassland at the edge of a cultivated field since about 1952.

Lamium album L. — WHITE DEAD-NETTLE. Scoggan (1957). Collected close to a hedge in an old perennial flower border in 1956, *1127*. The patch was destroyed by digging during 1963 and 1964.

Melissa officinalis L. — LEMON BALM. Stevenson (1963). First seen in 1961 in wasteland but not collected until 1962, *2777*. All plants were killed during the severe winter of 1962-63. It is known from Ontario and British Columbia. (B. Boivin, private communication).

Moldavica thymiflora (L.) Rydb. — SLENDER DRAGONHEAD. Collected along a hedge at the edge of a cultivated field in 1951, *471*. Persisting in the same general area but it has not spread to any great extent.

Solanum sarachoides Sendtner — Collected in 1959, *1959*, *2459*, in a grain field. It is frequently seen in the same general area as the original collection.

Plantago coronopus L. — BUCKSHORN PLANTAIN. Stevenson (1963). Collected, *2828*, in the introduction nursery, Experimental Farm, in 1962. It was probably introduced with seed of *Trifolium resupinatum* from Portugal. It did not persist. Recently it was found on Vancouver Island.

P. media L. — HOARY PLANTAIN. Stevenson (1957b). Collected in disturbed grassland in 1953, *807*. The original small patch has spread over a fairly large area. When the site was visited in 1964, many of the plants showed the characteristic twisting which follows the application of 2,4-D.

Campanula rapunculoides L. — CREEPING BELLFLOWER. Collected in 1953, *794*. Occasional patches appear along ditches, hedges and under trees. It is reported to be a troublesome weed in some local gardens.

Achillea millefolium L. f. *purpurea* (Gouan) Schinz & Thellung — PURPLE-FLOWERED YARROW. Boivin (1962). Collected, *1936*, in 1959 in the C.P.R. yards, Brandon, just west of the old station. A small patch was observed in the same area in August, 1964.

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VEGETATION ZONES AROUND WOODCHUCK BURROWS

H. GRAY MERRIAM AND AILEEN MERRIAM
Department of Zoology, University of Texas, Austin
and Austin, Texas

CHANGES IN VEGETATION associated with burrows of Eurasian marmots have received much study (reviewed by Formosov, 1928), and "Murmelthieregarten" was coined by Radde (1862) to designate the distinctive vegetation around marmot mounds. This phenomenon has gone almost unnoticed in this continent.

In at least some permanent pastures with a legume component in northeastern North America, there are easily visible zones in the vegetation around woodchuck burrows (Figure I). These zones do not occur in all woodchuck habitats; a broad survey of plant associations, soil types and other environmental characteristics would be required to determine which factors are prerequisite to zone formation. Vegetation around burrows is visibly most different from field vegetation during run-off following the final spring melt. Within one to three feet of the burrow, plants are taller and luxuriantly green compared to the generally chlorotic field vegetation. The color of the plants close to a burrow becomes less distinct later in the season but an additional zone of shorter, paler vegetation develops farther out from the burrow, moving the field vegetation boundary out several yards from the burrow (Figure I). In grazed pasture, this pattern is visible all summer. These differences in vegetation could be due to differences in species composition at different distances from a burrow or to physiological differences between plants, or both.

Results are presented here from an investigation of vegetation around eight burrow systems in two glacial till pastures near Ithaca, New York. The fields were adjacent and both were dominated by alfalfa (*Medicago sativa*) and timothy (*Phleum pratense*) with other grasses and forbes.

A 25 foot line transect was run out from one entrance of each burrow system. Stems of all species on the line were counted and were recorded in one foot intervals. Only data for the dominant alfalfa and grasses (including timothy) are analyzed here. The well known tendency for alfalfa stems, in older stands, to be highly clustered and the possibility that grasses may also be clumped by reciprocally filling the spaces between alfalfa clusters, recommends against statistical techniques based on the "normal" distribution. Therefore, non-parametric, rank sum tests (Tate and Clelland, 1959) were used to test various intervals of stem totals along the lines for differences in stem frequency.

For all lines, the total alfalfa stems per foot, in order from burrow to 25 feet, were: 3, 12, 13, 5, 18, 7, 14.86, 15, 13, 17.14, 22, 3.43, 13, 27.43, 18, 21.17, 5, 12.37, 34, 38.86, 36.57, 8.17, 36.57, 24. Fractional data are due to substitution for a few missing interval counts by the mean of all other lines for the same one foot interval. Two significant ($p \leqslant .05$) boundaries (three zones) in alfalfa stem totals for all lines were indicated at 5 and at 20 feet from the burrow. The mean number of alfalfa stems per foot: from burrow to 5 feet, from 5 feet to 20 feet, and from 20 feet into the field vegetation were, respectively, 1.28, 1.83, and 3.71.

Similar analysis showed a difference ($p < .05$) in grass stem counts only between the 8 feet nearest the burrow and the rest of the line. No division into the three zones found for alfalfa was indicated. The mean number of grass stems per foot: from burrow to 8 feet and from 8 feet into the field were, respectively, 6.99 and 8.63.

Because legumes are preferred by woodchucks (see, for example, Hamilton, 1934) and because trampling and grazing effects must centre on the burrow, it seems reasonable that these stem counts reflect attrition of grasses and legumes near the burrow. This may partially explain the shorter, lighter, vegetative zone bordering the field vegetation.

However, stem counts do not explain the visibly lush, green zone next to the burrow. This zone might be caused by several factors other than the kind and number of plants present. The possibility that vegetation differences around burrows were caused by differences in plant nutrients was tested by analysis of soil samples from each vegetation zone. A soil sample was taken one to two feet from each burrow and another from the next zone about 15 feet from each burrow. Twelve samples taken randomly from the fields were combined and analyzed in four samples. Analyses were done by the Agronomy Department, New York State College of Agriculture, Cornell University, by standard methods used for agronomic study. Results were obtained as pounds of nutrient per 2×10^6 pounds of soil for: P, nitrate N, Mg, K, Mn, Fe, and Al. Percent organic matter and pH also were measured.

Nutrient concentrations were analyzed by sign test (paired samples) and rank sum test. A general difference in nutrient concentration between the two fields studied could invalidate comparison of samples from a particular zone of both fields. This possibility was checked by testing for differences between the analogous samples of the two fields. Where the fields differed

FIGURE 1. Vegetation zones around woodchuck burrow near Markham, Ontario. Arrow indicates burrow entrance. Broken lines approximate zone boundaries.

significantly, comparisons between zones were made separately for each field. No significant differences between zones could be demonstrated in pH, organic matter, or any nutrient measured except nitrogen.

Woodchucks often defecate in underground side chambers but also deposit considerable amounts of feces in excavated soil at the burrow entrances. Merriam (1884) estimated 0.5 bushel of feces in one mound and Hamilton (1934), Grizzell (1955) and others found such deposits.

Soil nitrate nitrogen measurements: at burrows, 15 feet from burrows and in the field averaged 11.85, 8.50 and 7.00 (lb./2×10^6 lb. soil) respectively Nitrogen concentrations at burrows were significantly higher than in field samples ($p = 0.5$, one-tailed) and were almost separable from concentrations in samples taken 15 feet from burrows ($.10 > p > .05$, one-tailed). Clearly, nitrate is higher at burrows than in the field and the concentrations at 15 feet and in the field are inseparable. The mean differences suggest that most of the decrease between the burrows and the field occurs within a radius of less than 15 feet of the burrows.

It can be calculated that less than 6 pounds of feces added to a 10 foot diameter burrow zone could raise its mean nitrate nitrogen concentration from 7.00 to 11.85 lb./2×10^6 lb. soil. (The calculation excludes non-nitrate fecal nitrogen.) It seems feasible that fecal deposition around burrows could account for the measured nitrogen differences.

Additional nutrient analyses are needed and might be done more profitably on the plants. High nitrate assimilation can produce characteristics like

those of burrow zone plants and Wallihan (1947) found strong indications (statistically incomplete) of high nitrate assimilation in trees associated with woodchuck burrows. He compared trees with woodchuck burrows near their bases with others which were not associated with burrows but which were the same age and were in the same plantation. He found darker green foliage, increased height (by two or three times) and high micro-Kjeldahl nitrogen values in leaves of two hardwood species with woodchuck burrows at their bases.

Although there are several suggestions that the luxuriant burrow zone vegetation may be related to nitrogen levels, many other edaphic effects of the burrow could contribute. Deposition of subsoil on the surface around burrows and the related changes in weathering and fertility could be effective. Burrowing also could change infiltration and percolation of soil water and could change aeration. Appearance of the burrow zone under the saturated, poorly aerated conditions of spring run-off makes increased infiltration and aeration poor possibilities, but many remaining possibilities are poorly understood. Formosov (1928) and Grinnell (1923) discuss many such factors in reference to marmots and other burrowing rodents.

The lush appearance of the burrow zone, despite its lower stem counts, may be related to high soil or tissue nitrogen levels which could result from deposition of woodchuck feces around the burrow. The outer vegetation zone, between the burrow and field vegetation, could be caused by woodchucks removing about half the alfalfa stems and a smaller proportion of grasses while making only slight nutrient additions to most of this zone. The problem deserves more study.

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A NEW SANDHILL CRANE FROM CENTRAL CANADA

LAWRENCE H. WALKINSHAW
1703 Wolverine Tower, Battle Creek, Michigan

LINNAEUS (1758) described the first Sandhill Crane as [*Ardea*] *canadensis*, based on *Grus fusca canadensis* which was portrayed by Edwards (1750) from a bird taken at Hudson Bay, North America. Meyer (1794) described the next form as *Grus pratensis* based on Bartram (1791) from his Florida travels. Later Bangs and Zappey (1905) described *Grus nesiotes* from Isle of Pines and Cuba. Peters (1925) named the fourth form, *Megalornis canadensis tabida*, the type coming from Nevada. Since all four forms are quite similar in plumage, they are subspecificly classified under one species.

For many years I have analyzed the different measurements of *Grus canadensis*, adding new measurements from time to time. There is no long series of breeding birds in any museum but by bringing measurements from many museums and collections together, I have been able to bring out the results shown in Table I and the following pages.

The Sandhill Cranes breeding in Alberta, Saskatchewan, west-central Manitoba, and southern Mackenzie have not fitted with either *G. c. canadensis* nor with *G. c. tabida*. There is enough available material to show the Sandhill Cranes from these Provinces and southern Mackenzie are intermediate in size. Consequently I am describing these birds as a new subspecies:

*Grus canadensis rowani** new subspecies

CANADIAN SANDHILL CRANE

Type. ♂ – Chicago Natural History Museum, H. B. Conover Collection, No. 16013; 10 miles west of Fawcett, Alberta; William Rowan; 1 June 1943.

Description. The plumage is very similar to that of the other Sandhill Cranes. During summer many of these cranes near Fawcett, Alberta become very reddish brown apparently from iron salts in the soil and water. This is shown in the frontispiece in my book (Walkinshaw, 1949). The primary feather shafts are lighter than those of *G.c.canadensis.* The new race has a much longer tarsus than *canadensis* and usually a longer bare tibia but it is also shorter than in *G.c.tabida.* There is very little overlap in the measurements of the exposed culmen and less so in the measurement from the posterior part of the nostril to the tip of the upper mandible. The wing of the new race is shorter, but overlaps to some extent the wing of *G.c.canadensis,* but there is no overlapping at all between these birds and *G.c.tabida.* Those of the latter are longer. Measurements of the type are given in Table 1.

Range. The summer range of the new subspecies covers the Coniferous Forest Biotic Community in southern Mackenzie, Alberta, Saskatchewan, and probably central western Manitoba. It may occur in northern Ontario where

*Named for the late Professor William Rowan, University of Alberta, Edmonton, Alberta.

no cranes have been taken during the summer. From existing specimens it winters in southern and eastern Texas and there is one specimen from Cameron Parish, Louisiana (ROMZ).

In Table 1, I have listed a group of *G.c.canadensis* following which is a typical male specimen taken from near the type locality. These birds were all taken along the Bering Sea, in the Arctic, or on lands bordering Hudson Bay. The second group are the new subspecies from central Canada (southern Mackenzie, Alberta, Saskatchewan) along with the type. The third group is made up of Sandhill Cranes from the western United States. A Sandhill Crane specimen in the British Museum (Natural History) from Orcas Island, British Columbia, taken in June 1858, not sexed, indicates that the coastal birds there may be *G.c.tabida*. I have not found any summer specimens from central British Columbia.

Mailliard (1921) recorded seven winter male *G.c.tabida* and one female from California indicating that they were similar to those I have listed as breeders from Oregon, California, Nevada, Idaho, Wyoming, and Colorado. The California winter males from Merced County, Los Baños had an average wing length of 543.1 (502-564); tarsus, 241.7 (231-254); exposed culmen, 148 (138-170); depth of bill at base, 32.3 (29.2-40.1); and bare tibia, 102.7 (95-110) mm.

Eight male specimens of *G.c.tabida* taken during the summer in North Dakota (Ch.NHM,1), Minnesota (AMNH,MCZ), and Michigan (UMMZ,3, ME,LW), had an average wing length of 528.1 (500-549); tarsus, 245.9 (226-260); bare tibia, 112.8 (105-118); exposed culmen, 143.2 (133-159); and culmen from posterior edge of nostril to bill tip, 111.1 (99.5-121) mm. Five females from North Dakota (Ch.NHM,1) and Michigan (UMMZ,2,ME,LW) had wing chord measurements of 527.6 (503-575); tarsus, 232.2 (223-239); bare tibia, 103.3 (100-108); exposed culmen, 140.6 (137-147); and bill from posterior edge of nostril to tip, 103.1 (99-105.5) mm.

Ten males of *Grus canadensis pratensis* from Florida from Alachua County, Enterprise, Kenansville, and Tampa (MCZ,6;USNM,4) had wing chord measurements of 500.5 (465-525); tarsus, 247.2 (239-264); bare tibia, 118.3 (114-123); and exposed culmen, 123.1 (115-133) mm. While ten females (MCZ,3; USNM,4; AMNH,2;ChNHM,1) from Enterprise, Hendry, Jupiter, Kenansville, Tampa, W.Palm Beach, had wing measurements of 469.5 (458-517); tarsus, 233.1 (220-241); bare tibia, 110.5 (98-121); and exposed culmen, 120.5 (114-128) mm.

A typical *Grus canadensis pratensis* male from Alachua County, Florida (near the origin of the type specimen) taken 12 May 1881 (MCZ, 205614) had a wing chord measurement of 515; tarsus, 240; bare tibia, 123; and exposed culmen, 119 mm.

Six male *Grus canadensis nesiotes* from Isle of Pines and Cuba (MCZ) had an average wing chord measurement of 482.6 (460-496); tarsus, 216.3 (206-232); bare tibia, 101.8 (91-114); and exposed culmen, 116.6 (115-118) mm. Five females (MCZ,1;Ca.M,4) had an average wing chord of 440.8 (425-

TABLE 1.—Sandhill Crane specimens from breeding territories from late April to early July

Subspecies and where taken	Museums and collections	Wing chord	Tarsus	Exposed culmen	Bill from tip to posterior of nostril	Bare tibia
Grus canadensis canadensis *Males* (33). Siberia, Alaska, No. Canada, Hudson B. Is.	USNM, 9; ChNHM, 5; AMNH, 4; BM(NH), 3; Ca.M, 3; MCZ, 3; NMC, 3; ROMZ, 1; MVZ, 2.	475.6 (439–503)	186.6 (156–210)	91.8 (69–102)	71.4 (65–76)	70.3 (52–85)
Females (17). Alaska, Arctic Canada, Hudson Bay Is.	NMC, 6; USNM, 5; AMNH, 2; Ca.M, 1; Ch. NHM, 1; BM(NH), 1; MCZ, 1.	451.2 (420–490)	182.0 (162–198)	93.2 (84–103)	67.4 (63–74)	69.1 (50–83)
Typical *G. c. canadensis* Hudson Bay, Cape Low, Southampton Is., Male, 2 June 1930	Ca.M., 110285.	457	181	92		66
Grus canadensis rowani *Males* (7). So. Mackenzie, Alberta, Saskatchewan.	Ch.NHM, 3; ROMZ, 2; NMC, 1; USNM, 1.	507.3 (480–524)	222 (216–239)	118.3 (109–127)	85 (82–88)	86.6 (70–96)
Females (3). Alberta, Saskatchewan.	Ch. NHM, 1; NMC, 1; USNM, 1.	472.6 (456–495)	210.6 (205–216)	103.0 (93–114)	80 (73–87)	75.5 (63–88)
Type *Grus canadensis rowani* 10 mi. West of Fawcett, Alberta. Male, 1 June 1943, Wm. Rowan coll.	Ch. NHM, HBC coll., 16013.	524	216	117	88	95
Grus canadensis tabida *Males* (8). Oregon, Calif., Nevada, Idaho, Colorado, Wyoming.	USNM, 3; Cl.MNH, 1; CSAS, 1; Col. MNH, 1; MCZ, 1; UMMZ, 1.	561.5 (526–598)	244.5 (226–264)	137.1 (122–144)	107.2 (101–116)	111.2 (88–125)
Females (9). Oregon, Idaho, Wyoming, Colorado.	AGP, 2; AW, 1; Ch.NHM, 1; Cl.MNH, 1; Col.MNH, 1; SJ, 1; UISB, 1.	546.0 (510–575)	230.5 (222–239)	125.0 (113–134)	97 (1)	112.7 (108–117)
Type *Grus canadensis tabida* Valley of South Fork of the Humboldt River, Nevada. Male, 19 May 1859.	MCZ, 72675.	555	245	136		88

460); tarsus, 200.0 (187-218); bare tibia, 104.5 (95-109); and exposed culmen, 110.4 (100-122) mm.

The type of *Grus canadensis nesiotes* from La Vega, Isle of Pines, a male in MCZ, no. 13238, taken 8 May 1904 has a wing chord measurement of 496; tarsus, 221; bare tibia, 103; and exposed culmen, 117 mm.

I have not seen any specimens from the upper peninsula of Michigan but the birds appear smaller than those from southern Michigan as do the three specimens described by Boeker and Aldrich (1961).

Boeker, Aldrich, and Huey (1961) and Boeker, Huey, and Uzzell (1962) showed that cranes shot during the hunting season in eastern New Mexico and western Texas in winter were chiefiy *G.c.canadensis.* I have shown (1960) that apparently cranes from Michigan migrate southward to either southern Georgia or to peninsular Florida or both during winter.

Existing specimens, not entered in the following table because they lacked dates or sex, show that cranes from the region of Lake St. Martin, Manitoba (ROMZ) were definitely *G.c.rowani;* those from Wisconsin, Illinois, and Ohio were *G.c.tabida.*

Measurements are all given in millimeters. Birds were from the following museums and collections: AGP- A.G.Prill; AMNH — American Museum of Natural History; AW — Alex Walker; BM(NH) — British Museum (Natural History); Ca.M. — Carnegie Museum; CSAS — Case School of Applied Science; Ch.NHM — Chicago Natural History Museum; Cl.NHM — Cleveland Natural History Museum; Col. MNH — Colorado Museum of Natural History; LW — Lawrence Weller; MCZ — Museum of Comparative Zoology; MVZ — Museum of Vertebrate Zoology; ME — Miller Empey; NMC — National Museum of Canada; ROMZ — Royal Ontario Museum of Zoology; SJ — Stanley Jewett; UIBS — University of Idaho, Southern Branch; UMMZ — University of Michigan Museum of Zoology; USNM — United States National Museum.

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THE ANOSTRACA AND NOTOSTRACA OF CANADA WITH SOME NEW DISTRIBUTION RECORDS

Richard Hartland-Rowe
Department of Biology, University of Alberta at Calgary,
Calgary, Alberta

Introduction

There is little published information on the distribution of phyllopod Crustacea in Canada. The sections on the orders Anostraca and Notostraca in Edmondson (1959), by Dr. Ralph W. Dexter ond Dr. Folke Linder respectively, record the distribution of species by provinces and territories. These records are substantiated by specimens in one or more of the following museums: National Museum of Canada (NMC), Royal Ontario Museum (ROM), and the United States National Museum (USNM). More detailed information on the distribution of three of the species is contained in Reed (1963).

From Edmondson (1959) there appear to be published records of eight species of Anostraca and two species of Notostraca in Canada. The records presented here increase these numbers to sixteen and four respectively, and extend the known distribution of most of these species.

These records have been obtained by examination of material in the museums mentioned, material received from numerous individuals, and material collected by my assistants and myself since 1962.

Anostraca and Notostraca may be identified with the aid of Dexter's and Linder's keys in Edmondson (1959), but it should be noted that the genus *Branchinecta* presents problems. These are:

1. The nomenclature of certain species has been in dispute for many years. I regard this dispute as settled by Lynch (1964) and have adopted his nomenclature, which is different from that used by Dexter. For the three species concerned I give Dexter's terminology (which is that used by Mackin 1952) in parentheses.

2. One species, *Branchinecta campestris* Lynch, was described after publication of Dexter's key (Lynch 1960). This species may be added to Dexter's key by the addition of a third alternative to couplet 12, thus:
   12c Tips of distal segment of male clasping antenna hooked, foot-shaped .... *B. campestris* Lynch 1960

3. Some species of *Branchinecta* display considerable geographical variation. Dr. James E. Lynch, who was kind enough to examine my Alberta specimens, says (personal communication): "I would consider your specimens a distinct subspecies of *B. mackini*." and later: "this Canadian race appears to be a variety of *B. campestris*.". The other species he examined was *B. lindahli* which appears to be typical in form in Alberta.

The list which follows records the known distribution in Canada of all the Anostraca and Notostraca hitherto found, together with a brief note on the general distribution of each species. Additions to the Canadian or provincial faunal lists are indicated by an asterisk. Where a species is of wide distribution only a few selected locations are listed.

Unless otherwise indicated, the records were obtained by my assistants or myself. Our collections are in the Department of Biology, University of Alberta, Calgary. Specimens representative of new distribution records are being deposited in the National Museum of Canada.

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I wish to express my thanks to Dr. E. L. Bousfield of the National Museum of Canada, Dr. Glenn Wiggins of the Royal Ontario Museum, and Dr. Thomas E. Bowman of the United States National Museum for their kindness in permitting me to examine material under their care; to Dr. James E. Lynch for his identifications, drawings and notes on some of the *Branchinecta* species; to the many individuals who have sent me material, and to Mr. Gary Fabris, Mr. Stewart Anderson, Mr. Graham White, and others who have assisted me in the field and the laboratory.

NOTES ON THE INDIVIDUAL SPECIES

NOTOSTRACA

Triops longicaudatus LeConte (1846)

*Canada, *Alberta: 5 mi. W. of Tilley (1 VI 1963); Malta (28 VII year unknown) (specimens received from the Department of Zoology, University of Alberta, Edmonton).

This species is widespread in the western United States, Mexico, and at lower latitudes. Its presence in Canada is not surprising since it has been reported from Montana (Edmondson 1959); however these records do extend the known range northward.

Lepidurus arcticus Pallas 1793

Yukon Territory, Northwest Territories (Reed 1963).

This is a circumpolar Arctic species, restricted to high latitudes and cold waters (Koli 1957); it occurs in lakes as well as in smaller bodies of water (Poulsen 1939).

Lepidurus couesii Packard 1875

Alberta, Saskatchewan, Manitoba.

This is the most abundant species in Alberta and according to Edmondson (1959) also occurs in the northwestern United States, Russia, Northern Siberia and Turkestan.

Lepidurus lynchi Linder 1952

*Canada, *Alberta: 2 mi. S. and 14 mi. E. of Lucky Strike (15 V 1963); Farrell Lake, nr. Byemoor (7 VI 1963); Fleeinghorse Lake, Provost (14 VI 1963); Gillespie Lake, nr. Hayter (15 VI 1963); 1/4 mi. N. of Scapa (16 VI 1963); Dowling Lake (16 VI 1963); Sullivan Lake (20 VI 1951) (Zoology Dept. UAE).

*Saskatchewan: 22 mi. E. of Evesham (14 VI 1963).

This species is recorded from the western United States (Washington, Oregon, Nevada). The new records extend the known range significantly northward and eastward.

ANOSTRACA

Polyartemiella hazeni (Murdoch) 1874

Yukon and Northwest Territories.

This western Arctic species also occurs in Alaska.

Streptocephalus seali Ryder 1879

Alberta, *Saskatchewan: 6 mi. N. of Denzil (1 VII 1963); 14 mi. N. of Denzil (1 VII 1963); 14 mi. N. of Unity (3 VII 1963); Cypress Hills Provincial Park, near War Lodge Coulee (27 VI 1962) (ROM, coll. D. Barr).

This species is widespread throughout North America; its presence in Saskatchewan is not unexpected.

Branchinecta paludosa (O. F. Müller) 1788

*Alberta: 16 mi. E. of Keoma (6 VI 1963); Primate (15 VI 1963); 14 mi. S. of Consort (4 VII 1963); 4 mi. S. of Manyberries (15 V 1963); 9 mi. W. of Hanna (23 V 1963); 21 mi. E. of Hanna (23 V 1963); 1 mi. E. of Calgary (1 V 1962); 5 mi. W. of Calgary (2 V 1962); 2 1/4 mi. N. of Calgary (4 V 1932); 50 mi. N. of Wild Horse (22 V 1962).

*Saskatchewan: 17 mi. N. of Kerrobert (26 V 1963); 2 mi. N. of Denzil (1 VII 1963); 8 mi. N. of Denzil (1 VII 1963).

This circumpolar species occurs predominantly in Arctic and Subarctic latitudes, though specimens in the USNM are recorded from Wyoming. The records from Alberta and Saskatchewan fill a gap in the known distribution.

Branchinecta coloradensis Packard 1874
(*B. shantzi* Mackin 1952)

*Canada, *Alberta: 6 mi. N. of Calgary (17 V 1962); 50 mi. N. of Wild Horse (22 V 1962); 7 mi. E. of Balzac (31 V 1962); Drumheller (21 IV 1962); 1 mi. S. of Manyberries Experimental Farm (15 V 1963); 21 mi. E. of Hanna (23 V 1963); 17 mi. E. of Strathmore (26 VI 1963); 1 mi. E. & 12 mi. S. of Hussar (11 V 1965); 11 1/2 mi. E. of Bassano (11 V 1965); 15 mi. W. & 4 mi. S. of Steveville ferry (12 V 1965); 6 mi. W. of Sunnynook (12 V 1965).

*Saskatchewan: 17 mi. N. of Kerrobert (26 V 1963); 2 mi. N. of Denzil (1 VII 1963); 6 mi. N. of Denzil (1 VII 1963).

This species is widely distributed in the western United States; hitherto the northernmost records have been from Oregon and Wyoming.

Branchinecta packardi Pearse 1912
(*B. lindahli* Packard 1883)

*Canada, *Alberta: 1 mi. E. of Calgary (1 V 1962); 3 mi. E. of Balzac (31 V 1962); 1 mi. N. of Aden (14 V 1963); 17 mi. E. of Strathmore (25 VI 1963); 15 mi. W. & 4 mi. S. of Steveville ferry (12 V 1965); 4 mi. W. of Sunnynook (12 V 1965).

*Saskatchewan: 2 mi. N. of Denzil (1 VII 1963).

This species occurs almost throughout the Great Plains area of the United States, including Montana and North Dakota. The new records represent a slight northward extension of the known distribution.

Branchinecta mackini Dexter 1956

*Canada, *Alberta: 3 mi. E. of Calgary (16 V 1962); 12 mi. N. of Wild Horse (22 V 1962); 14 mi. E. of Lucky Strike (15 V 1963); 1/4 mi. S. of Hayter (30 V 1963); 9 mi. E. of Keoma (6 VI 1963); 2 mi. N. of Farrell Lake, nr. Byemoor (7 VI 1963); 6 mi. S. of Hardisty (8 VI 1963); Fleeinghorse Lake, Provost (14 VI 1963); Gillespie Lake, Hayter (15 VI 1963); 22 mi. S. of Castor (16 VI 1963); 1/4 mi. N. of Scapa (16 VI 1963); Dowling Lake, Dowling (16 VI 1963); 10 mi. E. of Metiskow (3 VII 1963).

*Saskatchewan: 1 mi. E. of Loverna (24 V 1963); 15 mi. N. of Unity (27 V 1963); Manito Lake, nr. Neilburg (29 V 1963); Vera (14 VI 1963); 22 mi. E. of Evesham (14 VI 1963); 2 mi. N. of Vera (3 VII 1963); 1 mi. N. of Winter (3 VII 1963).

The new records represent a significant extension to the known range of this species, previously recorded only from California, Nevada and Washington.

Branchinecta campestris Lynch 1960

*Canada, *Alberta: 3 mi. S. of Ribstone (29 V 1963); 1/2 mi. S. of Altario (30 V 1963); Gooseberry Lake, nr. Consort (3 VII 1963).

*Saskatchewan: 5 mi. N.W. of Vera (3 VII 1963).

This species is reported from Washington and Wyoming; the new records extend the known range northward and eastward. As mentioned above, Dr. Lynch remarks that the Canadian material submitted to him differs in slight respects from typical material.

Branchinecta gigas Lynch 1937

*Canada, *Alberta: 14 mi. E. of Lucky Strike (15 V 1963); Fleeinghorse Lake, Provost (14 VI 1963); 15 mi. S.W. & 4 mi. S. of Steveville ferry (12 V 1965).

*Saskatchewan: 22 mi. E. of Evesham (14 VI 1963).

This spectacular species occurs in the western United States, including Montana and North Dakota; the known range is extended northward by these records.

Branchinecta lindahli Packard 1883
(*B. coloradensis* Packard 1874)

*Canada, *Alberta: 1 mi. N. of Calgary (1 V 1962); 3 mi. E. of Balzac (1 V 1962, 28 IV 1965); 2 mi. N. of Balzac (31 V 1962); 2 mi. N. of Denzil (1 VII 1963); 1/2 mi. E. of Hussar (11 V 1965); 1 mi. E. & 12 mi. S. of Hussar (11 V 1965); 15 mi. W. & 4 mi. S. of Steveville ferry (12 V 1965).

This species is widespread in the western and Great Plains areas of the United States; the new records extend the known range northward.

Artemia salina (Linnaeus) 1758

*Alberta: 3 mi. S. of Ribstone (29 V 1963).

*British Columbia: Spotted Lake, Keremeos (7 V 1936) (ROM, coll. G. C. Carl); Salt Lake, Kamloops (- VIII 1936) (ROM, coll, G. C. Carl).

This species is worldwide in distribution and appears to exist wherever saline inland waters are present. Its presence in Alberta and B.C. is therefore not unexpected.

Artemiopsis stephanssoni Johansen 1922

Northwest Territories.

According to Dexter in Edmondson (1959) this is a western Arctic species, occurring also in Alaska.

Chirocephalopsis bundyi (Forbes) 1876

Yukon Territory, Alberta, Manitoba, Ontario, Quebec.

*Saskatchewan: 13 mi. N. of Kerrobert (26 V 1963); 1/4 mi. N. of Kerrobert (26 V 1963); 17 mi. N. of Kerrobert (26 V 1963).

This species is widely distributed in North America between approximately 40 and 65°N. latitude. The records from Saskatchewan fill a gap in the known distribution.

It may be noted here that a second species of *Chirocephalopsis* is widespread and abundant in Alberta; specimens of the same species from Massachusetts are in the USNM, and from Saskatchewan and Manitoba in the ROM.

Eubranchipus oregonus Creaser 1930

British Columbia: Little Mountain, Hope (9 V 1933) (NMC, coll. M. S. Ferguson); Langley (- IV 1935) (ROM, coll. G. C. Carl).

This species appears to have a peculiar distribution, occurring in the Pacific Northwest and also in Oklahoma.

Eubranchipus vernalis (Verrill) 1869

Ontario: St. Thomas (- V 1932) (NMC, coll. M. S. Ferguson).

This species is widespread in the eastern United States but does not appear to occur west of the Great Lakes.

Eubranchipus serratus Forbes 1876

*Canada, *British Columbia: Lac du Bois (14 V 1935) (ROM, coll. G. C. Carl).

This record extends the known range of this species northward from Washington. Besides occurring in the Pacific Northwest the species also occurs in several Midwestern States and in Virginia.

Eubranchipus ornatus Holmes 1910

Manitoba: Winnipeg (1 V 1928) (NMC, coll. F. Neave).

*Alberta: 5 mi. W. of Calgary (2 V 1962); 1 mi. N. of Cochrane (12 V 1965); 1/2 mi. W. of Conrich (4 V 1962); Drumheller (21 IV 1962); 1/2 mi. E. of Hussar (11 V 1965); 4 1/2 mi. S. of Cessford (12 V 1965); 6 mi. W. of Sunnynook (12 V 1965).

This species occurs in the Great Plains area of the United States; the new records extend the known range somewhat.

SUMMARY

Distribution records and brief notes are presented on the four species of Notostraca and sixteen species of Anostraca known to occur in Canada.

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OBSERVATIONS ON CANADIAN BIRCH (*BETULA*) COLLECTIONS AT THE MORGAN ARBORETUM. I. *B. PAPYRIFERA* IN EASTERN CANADA

W. H. BRITTAIN[1] and W. F. GRANT[2]
The Morgan Arboretum, Macdonald College, P.Q.

ONE OF THE MAIN PURPOSES for the establishment of the Morgan Arboretum at Macdonald College, on the west end of Montreal Island, was to secure and maintain a living collection of native Canadian trees for observation and study. In a collection of birches, which has been assembled from all across Canada and extending far north into the Northwest Territories and the Yukon, certain observations have emerged which appear worthy of record.

The native white or paper birch, *Betula papyrifera* Marsh., is a polymorphous species of continental range, in which a number of varieties have been recognized (Fernald, 1945). So numerous were the variants observed between individuals in our collection — even between trees growing side by side — that it was found difficult to define just what was a "typical" white birch. In trying to classify these variants we found that they did not invariably correspond to the definition of any named variety.

We have established seedlings on a common site in the Arboretum, where a comparison of juvenile characters, growth and development are continuously being carried out. While this aspect of the study will take considerable time to complete, the collection will form a useful reservoir of source material for future students. This paper presents some morphological observations from herbarium collections of *B. papyrifera* from Nova Scotia, New Brunswick and Quebec and correlates this information with chromosome numbers obtained from seedlings of these same collections.

[1]Scientific Advisor, The Morgan Arboretum.
[2]Associate Professor, Department of Genetics.

TABLE 1.—Observations on Nova Scotia, New Brunswick and Quebec collections

Acc. no.	Locality	Chromosome number	Stomatal size[1]	Remarks
1	Bridgewater, N.S.	84[2]		Bracts with ascending lateral lobes; very long stalks
2	Upper Vaughans, N.S.	84		Leaves lanceolate, but branches upright
4	Hall's Harbour, N.S.	70	38.34	Base of leaves subcordate or broadly rounded
5	West La Have, N.S.	84	39.28	Corresponds to var. *macrostachya* Fern.
8	Pictou, N.S.	70	44.63	Closely resembles No. 5
9	South Berwick, N.S.	84		Differs from the standard form (No. 19) in very long female catkins
10	New Albany, N.S.	84		Long, broadly lanceolate leaves, bract with long spike-like middle lobe
11	Culloden, N.S.	56		Leaves dark green; bract with ascending lateral lobes
12	Culloden, N.S.	56	44.53	Resembles No. 11
13	Culloden, N.S.	84		Resembles No. 12
15	Hall's Harbour, N.S.	84		Old tree near shore with blackish bark probably due to weather
17	Digby Neck, N.S.	70		Common type; differs from standard form mainly in ascending lobes of bracts
19	Morgan Arboretum, P.Q.	84	38.91	This specimen (Fig. 1) was arbitrarily chosen as a standard for comparison
51	Brier Island, N.S.	84[3]	41.25	Dark brown bark; bract with tapering median lobe; achene with short stubby stigmas
52	Brier Island, N.S.	84	42.28	Resembles No. 51, but differs in bracts with parallel sides
53	Brier Island, N.S.	84		Resembles No. 52
54	Brier Island, N.S.	84:70[4]		Resembles No. 51
63	Coldbrook, N.S.	84		Differs from No. 19 in bract with ascending lateral lobes
67	Clementsport, N.S.	70	41.16	Very old but healthy tree; achene with unusually long stigmas
68	Sackville, N.B.	70		Bract with long median lobe and ascending lateral lobes
69	Sackville, N.B.	84	44.34	Bract with lateral lobes extended or recurved
70	Grand Lake, N.B.	70:84[4]		Leaves lanceolate; branches drooping; lateral lobes spreading
72	Fredericton, N.B.	84	35.44	Resembles No. 10 most closely
75	Acadia F.E.S., N.B.	70:84[5]	36.00	Healthy stand with no sign of die-back; bract with lateral lobes sharply recurved
76	Pleasantville, N.S.	70		Differs from No. 19 in ascending lobes of bract
77	Blomidon, N.S.	70		Resembles preceding
95	Morgan Arboretum, P.Q.	70[2]	40.69	Leaves uniformally subcordate
149	Fredericton, N.B.	84	42.19	Resembles No. 19
150	St. John, N.B.	56	31.13	Large, healthy tree with small dark green leaves

TABLE 1.—(Continued)

152	Fredericton, N.B.	70[2]		Resembles No. 19, but with ascending lateral lobes
162	Monastery, N.S.	70		Resembles No. 5 and No. 8; stem of third year seedling, quite warty
238	St. Stephen, N.B.	84	38.91	Resembles No. 19

[1]Expressed in microns. Average of 20 measurements.
[2]Determination from 2 seedlings.
[3]Determination from 3 seedlings.
[4]Two seedlings with different chromosome numbers.
[5]Three seedlings examined; two with 84 chromosomes.

MATERIALS AND METHODS

Collections of *B. papyrifera* from natural stands in Nova Scotia (21 accessions), New Brunswick (9) and Quebec (2) have been examined for various morphological characters and the chromosome number determined for one or more plants grown from seed of each collection. The localities from which the different accessions have been obtained are given in Table I. Herbarium specimens from the parental trees and drawings and photographs of leaves, twigs, bracts, catkins and samaras have been made for each accession. When possible a portion of the bark of the mature tree has been attached to the herbarium sheet.

For purposes of comparison, we have arbitrarily chosen one individual tree (No. 19) growing wild in the Morgan Arboretum, which seemed to represent as well as any other the average type of *B. papyrifera* found in Eastern Canada. A brief description of this standard specimen indicating the significant characters is given below. This specimen falls within the description of the species as defined by Fernald (1950) and, therefore, a complete taxonomic description has not been given since Fernald may be readily consulted.

Foliage: Leaves ovate or ovate-acuminate from a cuneate base; blades on fertile shoots 5-9 cm. long, 3-4.5 cm. wide.

Male catkin: In cluster of 3, less commonly 2 or 4.

Female catkin: 3.7-4.5 cm. long.

Bracts: Horizontally diverging or slightly recurved; median lobe shorter than stalk; length 5.6 cm.

Juvenile stem and leaf: the juvenile stem is densely pubescent as is also the young leaf; the pubescence tends to disappear with age, but may persist, at least for a time, especially around the buds. On the leaf, patches remain at the base of the leaf and in the axils of the larger veins.

Samara: wing wider than achene, which is at least half as broad as long and densely hispidulous for at least one-third of its length; length of achene 1.9-2 mm, width 1.3 mm, stigmas rather short and stubby; width with wing 3.75 mm.

Bark: White, exfoliating (that is, peeling in layers).

Consideration of space has permitted the retention of only ten seedlings from each accession for observation. Somatic chromosome number determinations have been made from Feulgen squashes using phase contrast microscopy. The root tips were pretreated in 8-oxyquinoline and fixed in Carnoy's solution (ethyl alcohol : acetic acid, 3:1). Before squashing, the root tips were treated in 4 per cent pectinase for 1 hour, or longer, until the tissue readily separated into cells when squashed. Stomatal measurements were made on the lower epidermis of mature leaves from herbarium specimens of parental plants by the collodion technique (Long and Clements, 1934).

OBSERVATIONS

Table 1, and Figures 1 and 2, illustrate individual differences for the 32 collections of *B. papyrifera*. In Table I, chromosome numbers have been given for the progeny of one to three plants grown from seed for each accession. As may be seen in this table, three somatic chromosome numbers were represented in the entire population, namely, 56, 70 and 84, however, the first number was present in only three collections. Seedling plants showed some phenotypic variability in three collections and it was found upon cytological examination of the individual plants that one of the seedlings differed from the others in chromosome number (Acc. No's. 54, 70, and 75).

Stomatal measurements were of little use in distinguishing between individuals with different chromosome numbers as overlapping measurements and inconsistencies occurred.

Figures 1 and 2 illustrate representative collections and the numbers refer to accession numbers as given in Table 1.

DISCUSSION

A study of this material does indeed show a wide variation between collections and, though these variations appear to persist in any given tree from year to year, there appears to be no justification for segregating any segments of this collection into subspecific or varietal status at the present time. Somatic chromosome numbers of 70 and 84 have already been designated for specimens of *B. papyrifera* (Woodworth, 1929, 1930, 1931; Johnsson, 1949) which concurs with our finding, however, we have also found progeny of three collections with 56 chromosomes. Crosses between plants with 56 and 84 somatic chromosomes would also explain the presence of plants with a chromosome number of 70.

The presence of three collections with seedlings having different chromosome numbers from a *single* parental tree would indicate that there is little

FIGURE 1. Representative illustrations of leaves and catkins (reduced ca. 1/2), bracts and samaras (x ca. 8). The numbers refer to accession numbers as given in Table I. s= samara; b = bract.

barrier to cross fertilization between plants with different levels of polyploidy. It would appear, therefore, that hybridization between plants with different levels of polyploidy, and subsequent chromosomal and gene segregation, are the major causes for the polymorphism which is found in this species. Consequently, caution should be used, in correlating cytological and morphological observations in the birches since a single chromosome number determination from one plant of a collection is not necessarily representative of all the progeny of that collection.

Since varieties of *B. papyrifera* have been reported as having 56, 70 and 84 somatic chromosomes (Woodworth, 1931) we have considered our collection in the light of these varieties for the area under study as treated by Fernald (1945). One of these, *B. papyrifera* var. *commutata* (Regel) Fern., has been known as the "Western White Birch" but because of its very wide range Fernald considered the term to be a misnomer. The main diagnostic character of this variety is its close, dark brown bark. We have collected some brown barked specimens on Brier Island, Nova Scotia, a small windswept island projecting into the Bay of Fundy and subject to fog, rain and low summer temperatures. In these specimens the bark was a deep warm brown color. Moreover, there was no sign of white bark underlying the dark exterior layers in any of the specimens examined. We do not consider these Brier Island specimens to be identical with var. *commutata*. However, with the exception of one collection in which a somatic chromosome number of 70 was found, the remainder possessed 84 chromosomes which is the same as has been reported for var. *commutata* (Woodworth, 1931; Johnsson, 1949). Johnsson (1949) has also observed dark barked individuals in *B. verrucosa* ($2n = 28$) and *B. pubescens* ($2n = 56$). It would appear, therefore, that there is no relationship between bark color and chromosome number.

Whether the possession of this dark bark represents a true genetic difference or whether environmental factors enter into it, remains an open question. We do know that *B. papyrifera* var. *cordifolia* trees with dark bark are to be found in certain situations in Cape Breton Island, northern New Brunswick and Newfoundland. We also have a specimen of *B. caerulea-grandis* Blanch. from Grand Manan Island, N.B. with dark brown bark. Specimens of *B. populifolia* Marsh. with dark bark have also been observed on the top of Sutton Mountain, Quebec. It is also relevant to point out that the specimen of *B. papyrifera* var. *commutata* in the Arnold Arboretum (#12855-1-X) grown from seed obtained from Kaslo, British Columbia, has close *white* bark. It will be of interest to watch the future development of these seedlings, now growing in the Morgan Arboretum, together with others obtained in the lower Fraser Valley of British Columbia. At the moment we cannot convince ourselves that these Brier Island plants are identical with the large trees with dark bark found on the Pacific Coast and identified as var. *commutata*.

Coming now to *B. papyrifera* var. *elobata* (Fern.) Sarg., this variety was established on a single immature specimen from Mount Albert, Gaspe County, Quebec. It is described as having subrhombic dentate leaves, short pendulous

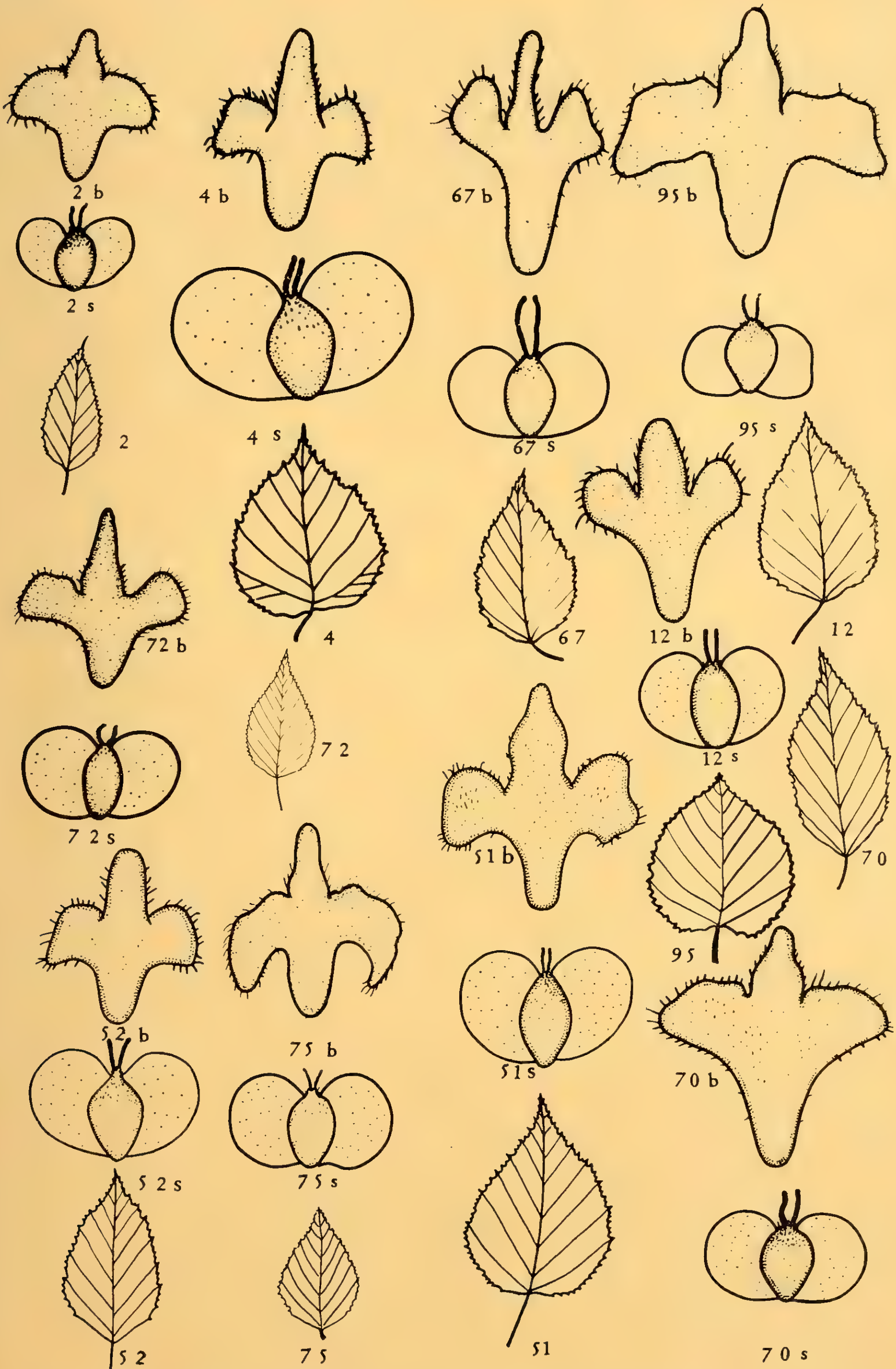

FIGURE 2. Representative illustrations of leaves, bracts and samaras. The numbers refer to accession numbers as given in Table I. s = samara; b = bract.

pistillate aments, with unlobed or obsoletely lobed bracts. This form must, however, remain a mystery, as it has only been recorded from the type locality and apparently has not been observed by other workers. Actually, the pistillate bract is one of the most variable features to be found in *B. papyrifera*, and in our own collections of *B. papyrifera* from different regions, some very odd forms occur, including some with reduced lateral lobes, though none have been completely missing. As an indication of the variability of bract form, a count of 150 specimens of *B. papyrifera* gave 44 individuals with extending bracts, 98 with ascending bracts and 8 with bracts sharply recurved. Moreover, these characters did not appear to be correlated with any particular form of leaf, seed, chromosome number or any other character.

B. papyrifera var. *pensilis* Fern. is described as a very striking type, not only as a weeping birch, but on account of the acute based leaves, and the very abundant fruiting aments. Our collection coming closest to this description is number 70 from Grand Lake, N.B. Our collection number 2 resembles it in foliar characters but was definitely not "weeping". However, we have not been able to convince ourselves that this is a stable variety.

Our collection number 5 corresponds to *B. papyrifera* var. *macrostachya* Fern. and collections of this variety have not only been obtained in Nova Scotia, but also in New Brunswick and Quebec. Fernald (1945) concludes that this is an intermediate type between *B. papyrifera* and *B. papyrifera* var. *cordifolia* with its large aments, bracts and samaras, as well as the tendency for its pistillate bracts to have the porrect lateral lobes of the latter, though sometimes nearly or quite as horizontal as in the former. The superficial resemblance is obvious, but it will be noted that for our three examples for which we have obtained chromosome number determinations, accession number 5 has a somatic chromosome number of 84 whereas 8 and 162 have 70.

Mention should finally be made of *B. papyrifera* var. *subcordata* Rydb. called the "Northwestern White Birch" and not reported in the East. Trees with subcordate leaves, however, do exist in the East, as for example our number 95. Our observations lead us to believe that shape of leaf base in *B. papyrifera* is an unsuitable character on which to judge varietal status and should be disregarded.

SUMMARY

Somatic chromosome numbers of 56, 70 and 84 have been determined for specimens of *Betula papyrifera* Marsh. collected in Nova Scotia, New Brunswick and Quebec. Two somatic chromosome numbers were found for *B. papyrifera* var. *macrostachya* Fern., namely 70 and 84. There appears to be little barrier to cross fertilization between plants with different levels of polypoidy and it is considered that subsequent chromosomal and gene segregation are the major factors for the extensive polymorphism found in this species. Specimens collected on Brier Island, Nova Scotia, possess dark bark. They are not considered to be identical to var. *commutata* and there appears to be no relationship between bark color and chromosome number. The shape of the leaf base in *B. papyrifera* is very variable and is considered an unsuitable character on which to base varietal status.

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TERRESTRIAL SOWBUGS (CRUSTACEA: ISOPODA) IN THE VICINITY OF LONDON, ONTARIO

W. W. JUDD

Department of Zoology, University of Western Ontario, London, Canada.

DURING THE SUMMER of 1964 a study of the distribution of terrestrial sowbugs in the vicinity of London, Ontario was made in connection with the programme of studies of non-insect invertebrates sponsored by the National Museum of Canada. Between May 11 and September 1 collections were made in twenty-six localities (lettered from A to Z, Figure 1). Each locality was visited three times during the season. Snowbugs were collected by removing the bark from logs and stumps, by turning over logs, boards, stones, piles of trash and other objects on the ground and by examining debris along the edge of bodies of water and damp areas in the various localities. In and around greenhouses a search was made beneath pots, potting benches and seed flats and in piles of manure and discarded plants.

The map (Figure I) was traced from the Lucan and St. Thomas sheets of the National Topographic series of maps and shows London and adjacent parts of London Township and Westminster Township in which collections were made. The North Branch and the South Branch of the Thames River meet in the centre of London to form one river which flows westward. Concession lines (3rd to 7th) shown on the map are those in London Township.

Sowbugs were identified with keys and descriptions in Van Name (1936) and Walker (1927). Mr. D. L. G. Noakes aided during the summer of 1964

TABLE 1. — Numbers of sowbugs collected in the twenty-six localities

Species	LOCALITIES																										Totals
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
Ligidium longicaudatum																				2	3					10	15
Trichoniscus demivirgo	21	55	90			4	65		41	76		33			38	27	16		10	94	86	83	4			48	791
Haplophthalmus danicus				1																							1
Tracheoniscus rathkei	283	165	140	236	182	143	195	374	162	197	134	184	181	295	198	284	278	76	301	181	199	173	201	159	388	149	5458
Porcellio scaber											28			12				14					2	108			164
Porcellio spinicornis				1		24													22			5	6			1	59
Cylisticus convexus	3	49	1	19		129	5	12		1					22	8	2	20	12	20		1	10	3			317
Oniscus asellus	6	61	112	7		48								16		1		22	79			10	191	6			559
Porcellionides pruinosus	2					23					48			1		1		200						8			283
Armadillidium vulgare						2					4			28				33						24			91
Armadillidium nasatum						9											8	23						35			75
TOTALS	315	330	343	264	182	382	265	386	203	274	214	217	181	352	258	321	304	388	424	297	288	272	414	343	388	208	7813

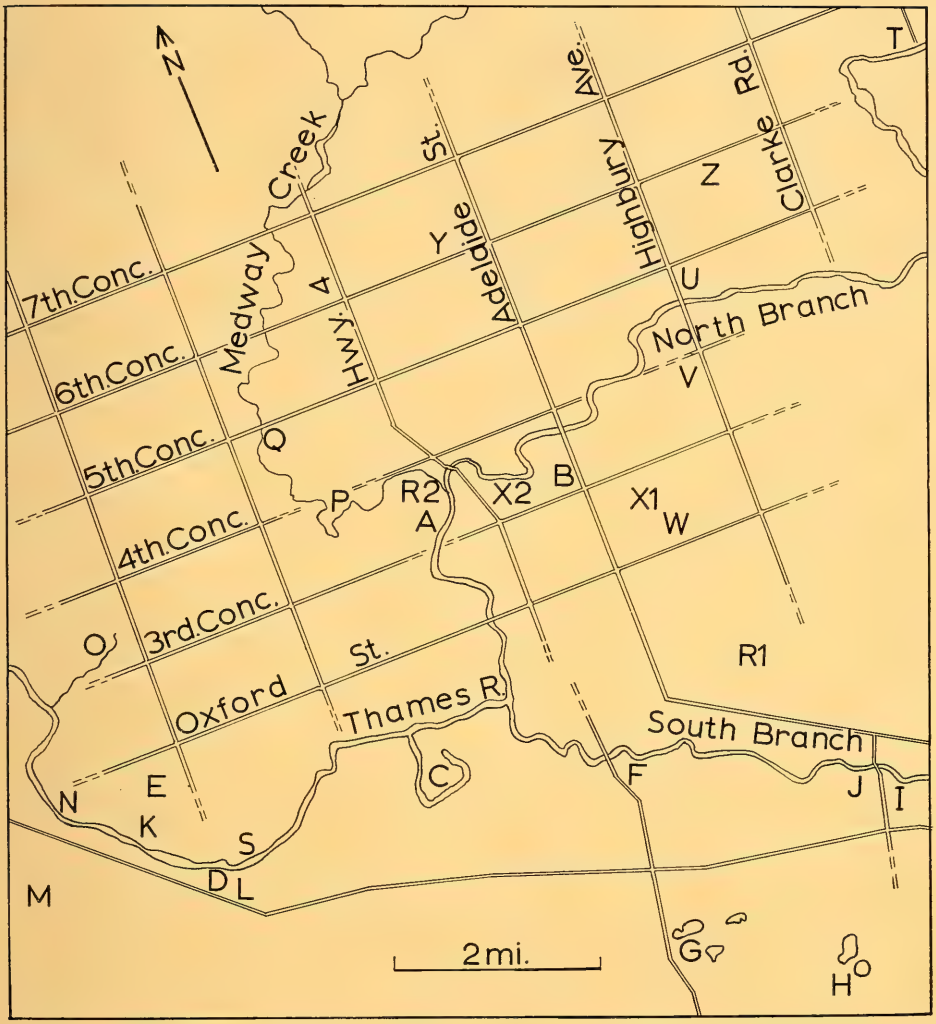

FIGURE 1. Map of London and vicinity showing localities (A - Z) in which sowbugs were collected.

in collecting, sorting and identifying the specimens. Representative specimens of the various species collected are deposited in the collections of the Natural History Branch of the National Museum of Canada and of the Department of Zoology, University of Western Ontario. The numbers of specimens of each species collected from the twenty-six localities are shown in Table I.

The localities in which collections were made and the dates of collection are as follows:

A. Grounds of the University of Western Ontario (May 11, June 17, July 27): pathways, copses, river banks.

B. Winnett Swamp (May 12, June 18, July 28): damp soil and river banks overgrown with trees and shrubs.

C. The Coves (May 13, June 19, July 29): a low plain surrounded by a backwater of the Thames River and with scattered trees and shrubs.

D. Springbank Park (May 14, June 22, July 30): lawns, wooded gullies and river bank.

E. Byron Bog (May 15, June 23, July 31): a black spruce-sphagnum bog surrounded by wooded slopes (Judd, 1957).

F. Watson Street Dump (May 19, June 24, August 4): city dump with mounds of household debris, ashes and soil; river bank nearby.

G. Walker Ponds (May 20, June 25, August 5): three kettle lakes surrounded by slopes wooded with deciduous trees.

H. Pond Mills (May 21, June 26, August 6): two ponds surrounded by grassy and wooded slopes.

I. Banks of South Branch east of Meadowlily Road (May 22, June 29, August 7): open fields and wooded banks along the river. Meadowlily Road runs north and south between I and J.

J. Banks of South Branch west of Meadowlily Road (May 23, June 30, August 10): open fields and wooded banks along the river.

K. Greenhouses (May 25, July 1, August 11): Davis', 1185 Riverside Drive; Sanderson's, 1265 Riverside Drive.

L. Reservoir Park (May 26, July 3, August 12): steep slopes wooded with deciduous trees.

M. Goldenwing Woods (May 27, July 6, August 13): well-drained woodlot of deciduous trees.

N. Banks of Thames River at Beck Memorial Sanatorium (May 28, July 7, August 14): fields and steep wooded slopes along the river.

O. Stream at west end of Third Concession (May 29, July 9, August 17): deep gully with wooded slopes along a small stream.

P. Valley of Medway Creek at 4th Concession (June 1, July 10, August 18): steep gullies and flood plain with woods on the slopes and rank weeds on the plain.

Q. Valley of Medway Creek at 5th Concession (June 2, July 13, August 19): broad, flat, grassy plain along the creek.

R. Greenhouses (June 3, July 14, August 20): R1—Sharratt's, 1085 Brydges St.; R2—University of Western Ontario.

S. Thames Valley Golf Course (June 4, July 15, August 24): golfing greens bordered by wooded banks of the river.

T. North Branch east of Clarke Road and south of 7th Concession (June 5, July 16, August 25): steep wooded banks with marsh and swamp at the lower levels.

U. White Cedar swamp at southeast corner of Highbury Avenue and the 5th Concession (June 8, July 17, August 26): low, damp ground under white cedars.

V. Marsh at southwest corner of Highbury Avenue and 4th Concession (June 9, July 20, August 27): several small, open marshes among fields along a tributary of the North Branch.

W. Backyards and alleys in northeast London (June 10, July 21, August 28): garbage cans, garden litter and piles of boards and stones.

X. Greenhouses (June 11, July 22, August 29): X1—Taylor's, 125 Barker St.; X2—Burston's, 251 Epworth Ave.

Y. Marsh on 6th Concession west of Adelaide St. (June 12, July 22, August 31): open cat-tail marsh in low ground.

Z. White Cedar Swamp south of the 6th Concession road and east of Highbury Ave. (June 16, July 24, September 1): low, damp ground beneath white cedars bordering a stream.

ACCOUNT OF SPECIES COLLECTED

LIGIIDAE

Ligidium longicaudatum (Stoller)

This species was found in only three localities (T, U, Z) in the northeast part of the collection area, in low ground under logs by water and in piles of soaking wet leaves and wet moss. The presence of this species in wet places is in accord with the reports of Van Name (1936) and Walker (1927) that it occurs in such situations.

TRICHONISCIDAE

Trichoniscus demivirgo Blake

This species was found in seventeen of the collection localities where shaded, damp conditions prevailed. Although some were found under wet leaves on wooded slopes, the majority were near water under objects at the water's edge or in permanently damp sites nearby. This species predominated in areas (T, U, Z) where it was in company with *L. longicaudatum.*

Haplophthalmus danicus Budde-Lund

Only one specimen was collected, being found under wet leaves on a steep hillside in Springbank Park (D). This species has previously been collected by Walker (1928) near Toronto under limestone blocks and has been recorded from Maryland by Van Name (1936).

ONISCIDAE

Tracheoniscus rathkei Brandt

This species was the commonest one collected and comprised more than half the collection and was found in all collection localities. While it was found in all sorts of situations it was least common in permanently wet and swampy areas and most common in drier, wooded situations as on the wooded slopes of ravines and in woodlots. It was the only sowbug found on the wooded slopes of the Byron Bog (E), a site where it was previously found in 1961 in company with a few *Cylisticus convexus* (Judd, 1963).

Porcellio scaber Latreille

The great majority of this species were found in greenhouses (K, R, X) under loose boards, bricks and seed flats and at the base of cement walls. Some were also found outside greenhouses under rubbish and boards near the buildings. A few were found behind the buildings of the sanatorium (N) under rubbish and stones and under wet leaves in backyards (W). The predominance of this species in these sites is in accord with the report of Van Name (1936) that this species is a native of Europe which has followed human settlements throughout the greater part of the world.

Porcellio spinicornis Say

This species occurred in several localities such as wooded slopes (D), backyards under rubbish (W) and swampy ground (V, Z) but predominated in sites along the edge of the river (F, S) where it was under wet logs and stones close to the water's edge. Its scattered distribution in the vicinity of London is in accord with the report of Walker (1927) that is not rare but decidedly local.

Cylisticus convexus (DeGeer)

This species occurred in a variety of situations, beneath logs, rubbish and damp

leaves. In those localities in which it was most prevalent (B, F) it was found in largest numbers under stones and blocks of cement near the water's edge. This accords with the report of Hatchett (1947) that this species is found particularly on river banks and in rocky situations.

Oniscus asellus L.

This species occurred in a variety of situations, under logs, stones and damp leaves. Where it occurred in largest numbers (C, W) it was under accumulated rubbish and garbage cans in backyards and alleys. A few also were found in greenhouses (R, X). Van Name (1936) records that this species is found in gardens, hothouses, and elsewhere in the vicinity of human settlement.

Porcellionides pruinosus (Brandt)

A few were found in the open and around a dump (F) but the great majority were in and around greenhouses (K, R, X) beneath boards, seed flats and piles of rubbish. It thus appears to be a species closely associated with human settlement, specially in greenhouses.

ARMADILLIDIIDAE

Armadillidium vulgare (Latreille)

Some were found in refuse heaps (F, N) on dumps or near buildings but the majority were in and around greenhouses (K, R, X). This is in accord with reports by Van Name (1936) and Walker (1927) that this species is most numerous in greenhouses and may damage cultivated plants.

Armadillidium nasatum Budde-Lund

A few were found around refuse in the open (F, Q) but most, as in the case of the previous species, were in and around greenhouses (R, X). Van Name (1936) and Walker (1927) record this species as a pest in greenhouses.

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Received for publication 17 December 1964

REVIEWS

Wild Captives

By Donald G. Dodds. The Macmillan Company of Canada Limited. 1965. 110 pp. $3.95.

Every reader will no doubt find *Wild Captives* a fascinating and enriching book. Donald Dodds evidently has a thorough knowledge and a profound understanding of his subject: the wild mammals of Newfoundland and the habitat in which they live. Otherwise, he could not have written such a book. The author also has an outstanding ability to write, reflected in the manner in which the environment and its inhabitants are described; the terms used are concrete and objective, the style is direct and without anthropomorphic considerations. The reader can feel the beauty and grandeur of the northern forest from the accurate picture presented by the author.

All this contributes to making the book easy to read and may even convey the impression that *Wild Captives* is but another collection of entertaining animal stories. This is not so; the book carries a message and is thought-provoking. This is not a text which one reads and then conveniently forgets about! Rather, one would like to discuss with the author some of the concepts or opinions which he expresses without entering into any lengthy philosophical dissertation. Is death an inherent component of life or is it accidental to it? Does man appear into the animal world as an intruder bent upon destruction, or is he an essential part of an environment which he has not yet learned to respect because of a lack of knowledge or understanding? Will man soon find his place in the community and assume the responsibilities incumbent to him, or will he destroy his habitat through the misuse of the great forces at his command?

These questions, and many more, will haunt the reader and challenge him. If improved knowledge leads to a proper respect of nature, then *Wild Captives* will have moved us a good, long step forward.

Louis Lemieux

Wildlife Service
Fish and Game Branch
Department of Tourism
Parliament Buildings, Quebec, P.Q.

Biology Data Book

Compiled and edited by Philip L. Altman and Dorothy S. Dittmer. Federation of American Societies for Experimental Biology, Washington. 1964. xix + 633 pp. $10.00 (U.S.).

This is "a volume of broad scope and limited coverage designed to serve as a basic reference in the field of biology". Its broad scope involves quantitative and descriptive tables, charts and diagrams contributed and reviewed by 470 leading biologists and organized in 13 sections, viz, Genetics and Cytology, Reproduction, Development and Growth, Morphology, Nutrition and Digestion, Metabolism, Respiration and Circulation, Blood, Biological Regulators and Toxins, Biophysical and Biochemical Characteristics, Environment and Survival, Parasitism, Materials and Methods, plus an appendix containing summary classifications of animals and plants, conversion factors, etc. The coverage is limited to about 400 species of common plants and animals, physiologically unique forms or size extremes within taxonomic groups. Man, laboratory and domestic animals dominate many animal tables while agricultural and horticultural plants and forest trees are predominant among plant tables, although a wide variety of other organisms is included throughout. Within tables, the organisms are usually grouped by classes while genera or fami-

lies are arranged alphabetically therein. Grouping the genera by orders and/or families would have greatly facilitated locating facts on single species and making comparisons between groups.

This book is a vast improvement over its 1956 predecessor, the *Handbook of Biological Data,* because of the inclusion of literature citations and a detailed index. It should be very useful to many indoor laboratory biologists with physiological, biochemical or pathological interests and problems, and deserves a place in the library of every university department concerned with the biological sciences. To most field-naturalists, however, it would be of very limited use, although occasionally one might profitably consult such tables as those on life history data, host-parasite relations and perhaps the classification summaries, although most of this information is fairly readily available elsewhere.

DONALD A. SMITH

Department of Biology
Carleton University
Ottawa 1, Ontario

Vascular Plants of the Pacific Northwest

By C. LEO HITCHCOCK, ARTHUR CRONQUIST, MARION OWNBEY, and J. W. THOMPSON. University of Washington Press, Seattle. Part 3, 1961, 614 p. $13.50; Part 2, 1964, 597 p. $15.00.

This five-volume series of which parts 2 to 5 have been completed will be of interest to all serious students of the flora of the Pacific Northwest. Since the end of World War II there has been a spate of regional and local floras published in North America. Many have been carefully prepared and are outstanding contributions but few contain such a wealth of information and are of such a high standard as *Vascular Plants of the Pacific Northwest.* The region covered by this flora includes all of Washington, northern Oregon, Idaho north of the Snake River plains, the mountainous regions of western Montana, and southern British Columbia. The area circumscribed has no definite boundaries to the north or south but this is not of great importance. The accurate delimitation of floristic zones is difficult and the boundaries which are usually arbitrarily drawn are a compromise based on our knowledge of the climatic, floristic, topographic and edaphic factors involved. The authors have had many years' experience with floristic problems in this region. Their wide field experience has enabled them to critically discuss a number of specific taxonomic problems, in the past they have contributed monographic treatments for some genera, and in some cases complex groups of species have been studied in detail. Many will disagree with their taxonomic treatments of some genera but this is inevitable when a large number of taxa are involved and an area is floristically and phytogeographically complex.

Part 3, a treatment of the Saxifragaceae (Saxifrage Family) to the Cornaceae (Dogwood Family) was prepared by C. Leo Hitchcock with the exception of the genus *Rosa* and the Umbelliferae (Parsley Family) which were contributed by Arthur Cronquist. Part 2 which completes the Dicotyledonae contains the families Salicaceae (Willow Family) through to the Crassulaceae (Stonecrop Family). Hitchcock was again the major contributor and was responsible for all families but the Salicaceae prepared by Cronquist. The sequence of families is that of Engler, but in each family the genera and species in each genus are in alphabetical sequence. Such an arrangement of genera and species is a consistent time-saver and should be adopted by more authors even though it obscures taxonomic relationships. In the introduction to part 3 under the heading *Phylogeny* Cronquist briefly discusses his reasons for not following a system for the dicotyledons which he published in 1957. This part also contains synoptical

and artificial keys for the dicotyledons which are treated in parts 2 to 5.

Like the preceding volumes parts 2 and 3 contain keys to genera, species and infraspecific taxa; descriptions of families, genera and species; and the locality, collector, date of collection and bibliographic reference of the type collection for each species and its synonyms. Under each species there are notes on distribution, habitat and flowering period. Where there are evident taxonomic problems, these have been pointed out and discussed often in considerable detail. In part 2 eight new varieties are recognized; in part 3 two new species, *Ribes hendersonii* Hitchc. and *Astragalus amnis-amissi* Barneby and six new varieties are described. The illustrations which are by Jeanne R. Janish show both general habit and detail and are conveniently placed near the text for rapid consultation. These line drawings are scientifically accurate and of the same high standard as those she prepared for part 4 of the series. As genera and species within a genus are arranged alphabetically, there is no general index. However one has been prepared for synonyms when a genus is represented by more than six species or when the synonymy is complicated. Common names have been included in the index when appropriate ones are available. There is no glossary but presumably one will be provided in part 1, the final volume of the series.

The conservative taxonomic treatment of the authors is amply evident in the large number of species that have been placed in synonymy or relegated to a lower rank. Such conservatism can usually be readily justified as many genera and groups of species are not well understood. In some cases, however, such as in *Antennaria* and *Petasites*, it has resulted in an oversimplification of the problems involved. On the other hand in such critical genera as *Amelanchier*, *Lupinus*, *Potentilla* and *Epilobium* new subspecific combinations have been made with what seems little justification in "species" that already have a voluminous synonymy.

A number of features have been included in *Vascular Plants of the Pacific Northwest* which might well be adopted in more manuals: Carl S. English and Brian O. Mulligan of Seattle have supplied notes on the ornamental value of many of the trees, shrubs and showy herbaceous plants; many of the more recent taxonomic monographs have been cited following the generic descriptions; and chromosome numbers have been included for many taxa although unfortunately without documentation. This flora is not a mere compilation. The descriptions are original, each species has been critically treated, and the text has obviously been carefully composed. The inclusion of critical discussions in the taxonomically more difficult groups, a virtually complete synonymy and the many other features ensure that *Vascular Plants of the Pacific Northwest* will be an essential reference work for many years to come.

As *Vascular Plants of the Pacific Northwest* includes southern British Columbia it will have a special appeal to those interested in the flora of this province. However, its usefulness should not be judged only on the basis of the region it covers. It contains pertinent discussions and much information that will be of interest to those working outside the region in the fields of biosystematics, cytology and plant geography. I strongly recommend this flora to both the amateur and professional and would like to stress that it is indispensable to those interested in the flora of the Pacific Northwest.

J. A. CALDER

Plant Research Institute
Central Experimental Farm
Department of Agriculture
Ottawa, Ontario

The Widespread Pollution of Soil, Water and Living Things by Toxic Chemicals Used in Insect Control Programs: An Introduction to the Subject through Direct Quotations from Published Reports.

Compiled by M. T. MYRES. (mimeographed), September, 1964. *Available from*: The Department of Biology, University of Alberta at Calgary, Calgary, Alberta, *or* Mr. Darrell Eagles, Canadian Wildlife Service, Ottawa, Ontario.

An Introduction to the Literature of the Effects of Biocides on Wildlife and Fish: A Select Bibliography.

Compiled by M. T. MYRES, (mimeographed), September, 1964. *Available from*: The Department of Biology, University of Alberta at Calgary, Calgary, Alberta.

In these mimeographed reports a serious attempt has been made to bring together background material on pollution of the environment by pesticides which should be of concern to all citizens and particularly to administrators of renewable resources. The literature on the subject is expanding rapidly. The reports provide up-to-date information.

V. E. F. SOLMAN

Canadian Wildlife Service
Ottawa, Ontario

Conservation — In the People's Hands

Published by the American Association of School Administrators, 1201 Sixteenth Street, N.W., Washington, D.C., 1964, i-ix, 321 pp. $6.00.

This excellent book presents in clear, concise language, the broad story of conservation. While the examples used are taken from the United States the ideas and concepts presented so well have world-wide application.

Resource conservation is dealt with as an art, a science, an exercise in public education and commitment and as a demonstration of democracy in action. Excellent chapters provide case histories of the resource conservation and sociological aspects of the Tennessee Valley Authority program, of the reasons behind the changing use of resources in resource-rich West Virginia and of the results of air pollution abatement in Pittsburgh and Allegheny county during the past 20 years. The success attained in those areas holds out both hope and ideas for more rewarding and more meaningful future use and enjoyment of resources through application of information now available.

Outdoor education with its ability to enrich all our lives is discussed in ways which suggest an approach to a more rewarding use of time in the dawning age of leisure.

Those interested in natural resource use can gain much from both the historical and the up-to-date information presented so clearly in this attractive book.

V. E. F. SOLMAN

Canadian Wildlife Service
Ottawa, Ontario

Pesticides and the Living Landscape

By ROBERT L. RUDD. The University of Wisconsin Press, Madison. 1964. 320 pp. $7.80. Distributed by Burns and MacEachern Limited, Don Mills, Ontario.

The author documents the sad story of pesticide use from the inorganic poisons of 60 years ago to the persistent organics of the last 20 years. He says, "My point is a simple one – in a limited way insect control is successful. I use 'limited' to emphasize that the reduction in numbers is usually local and temporary. Most insect control leads neither to total removal of the pest species nor to reduced necessity for its control" . . . "My focus in this book has been on the adverse effects of pest control". Later on, the author poses a number of pertinent questions. "Does pest control accentuate the existent trend toward simplified biological environments? Does it aid in the dispersal of pest organisms? Are we presently reducing desirable species of plants and animals to extinc-

tion through pest control? Are we unknowingly producing changes in biotic make-up over large areas? Or, in still more topical terms are we producing 'biological deserts'? Is plant control on roadsides and utilities rights-of-way a hazard to the native biota? One might pose other questions. The answer to all those above is a qualified yes."

The generalities of the story are, unfortunately, familiar to too small a part of our population. The details are well chosen and the documentation is excellent. This book should be as widely read as *Silent Spring* by all to whom our flora and fauna are a precious part of our heritage. It will help to turn the tide away from broad spectrum, persistent pesticides to those more delicate, selective methods of control which will, in the long run, succeed. The earlier chemicals have failed to achieve desired control because of development of resistant strains of pests and through causing major damage to normal biological control mechanisms.

V. E. F. SOLMAN

Canadian Wildlife Service
Ottawa, Ontario

Resources for Tomorrow

By JAMES SAVAGE. MacMillan of Canada, Toronto. 1963. 246 pp. illus. $2.95.

This short book covers conservation of renewable and non-renewable resources on the broadest possible basis. It makes some of its important points by treating events such as the restoration of a worn-out farm as short stories about the people involved.

The author groups his 30 chapters under general headings including the earth, the soil, water, the forest and man and nature. The problems dealt with range from wind erosion of misused soil to pesticide pollution of water with its damage to aquatic life.

The 30 chapters are followed by more than 250 searching questions — to test the student's comprehension of the material so well presented. There is in addition a bibliography of 36 well-chosen titles for further reading and a list of 46 films which can be used for visual reinforcement of the conservation story.

General notes for the teacher are supplemented by helpful detailed suggestions for relating conservation to the teaching of history, geography, English, mathematics, French, Latin, health, chemistry, household economics and shopwork. There are no special references to biology, physics, geology and forestry because the entire book has demonstrated the part those sciences play in man's whole ecology.

Although designed for teaching the book will help any reader who desires a broad introduction to ecology, including that of man himself. Rarely has this reviewer had the pleasure of recommending a book so highly for the natural history reader.

V. E. F. SOLMAN

Canadian Wildlife Service
Ottawa, Ontario

OTHER NEW TITLES

***Conepatus talarae* n. sp. from the Talara Tar-seeps, Peru**

By C. S. CHURCHER and C. G. VAN ZYLL DE JONG. Royal Ontario Museum, University of Toronto. Life Sciences Contribution 62. 1965. 15 pp. $1.00.

A Pleistocene Fauna from the Santa Elena Peninsula, Ecuador

By A. GORDON EDMUND. Royal Ontario Museum, University of Toronto. Life Sciences Contribution 63. 1965. 21 pp. $1.00.

A Review of the Flat-headed Bats of the Family *Molossidae* from South America and Africa

By RANDOLPH L. PETERSON. Royal Ontario Museum, University of Toronto. Life Sciences Contribution 64. 1965. 32 pp. $1.25.

A Review of the Bats the Genus *Ametrida*, Family *Phyllostomidae*

By RANDOLPH L. PETERSON. Royal Ontario Museum, University of Toronto. Life Sciences Contribution 65. 1965. 13 pp. $0.75.

The International Council for Bird Preservation, British Section, Annual Report for 1964.
(c/o Natural History Museum, Cromwell Road, London, S.W. 7) 1965. 40 pp. Three Shillings.

Seashore Life
By GILLIAN MATTHEWS and PETER PARKS. Puffin Picture Book No. 120. Distributed in Canada by Longmans Canada Ltd., Paperback Division, 55 Barbar Green Road, Don Mills, Ontario. 32 pp. $1.25.

NOTES

A New Northern Record for the Mockingbird, *Mimus polyglottos*

ON October 25, 1963, Dr. Richard F. Johnston and I observed a Mockingbird at the University Farm in Edmonton, Alberta. The identification was certain as this bird was seen at a distance of 20 feet both on a fence post and while feeding on the ground.

Previously published Alberta localities include Didsbury (A. O. U. Check-list of North American Birds, 1957, p. 423); Beynon, Huxley, Calgary and Okotoks, (W. R. Salt and A. L. Wilk, 1958, *Birds of Alberta*, p. 324). Recent unpublished records for Alberta, kindly made available by W. Ray Salt, include a second sight record at Beynon on May 23, 1959 and one at Rockyford on May 29 and June 1, 1960. As Grinnell and Miller point out (1944, Pacific Coast Avifauna No. 27: 344) Mockingbirds have been spreading northward during the past several decades, presumably due to general climatic warming. Indeed the bird observed on October 5, 1962 at Prince Albert, Saskatchewan (1963, The Blue Jay 21(1): 14) was encountered at that northern latitude during a very mild fall. The fall weather conditions in central Alberta prior to this sighting were also remarkable. There had been no snow and only a few frosts had occurred.

VICTOR LEWIN

Department of Zoology
University of Alberta
Edmonton, Alberta
13 November 1963

The Snake Fauna of Western Prince Edward Island

A FEW SPECIMENS of only two species of snakes from Prince Edward Island are represented in Canadian museums. (Cook 1960, *An analysis of the herpetofauna of Prince Edward Island*, unpublished Masters thesis, Acadia University, *and* National Museum of Canada Bulletin, *in press*). These are *Storeria occipitomaculata occipitomaculata* (Storer) the Northern Red-bellied Snake and *Thamnophis sirtalis pallidula* Allen the Maritime Garter Snake.

Opheodrys vernalis vernalis (Harlan) the Smooth Green Snake has been assumed to be present on Prince Edward Island from verbal reports but no specimens have been deposited in collections.

During the summer of 1964 an effort was made to collect specimens of snakes in Prince County. The specimens collected, which included *O. vernalis*, are listed below. All were deposited in the museum of the Fisheries Research Board of Canada, Biological Sub-Station, Ellerslie, P.E.I. In the lists below the code FRBE before each serial number denotes this museum. All specimens and complete details of capture location have been forwarded to the National Museum of Canada, for examination by Mr. Francis R. Cook. Specimens will be deposited in the National Museum and detailed descriptions will appear in Mr. Cook's forthcoming paper (Cook, *in press*).

Data for the specimens collected are as follows. All were taken in Prince County.

Storeria occipitomaculata occipitomaculata: Five specimens of the Northern Red-bellied Snake were collected and others were observed. The species must be considered to be common in the area. Specimens: FRBE 51 R, Tyne Valley, September 7, 1964, in dry ditch bordering farm land; FRBE 54 to 57 R, Murray Road, September 26, 1964, in trench cut for drain which served as a pit trap. The location was in open, mixed woodland.

Thamnophis sirtalis pallidula: The Maritime Garter Snake is very common, many were seen throughout the summer on hot days. Six specimens were collected. Five of the specimens were typical of *pallidula* in having conspicuous lateral spots and indistinct dorsal stripe. None had the orange dorsal stripe described by Cook (1960) for some Prince Edward Island specimens. One specimen was peculiar in that the lateral stripes as well as the dorsal were indistinct and incomplete. Specimens: FRBE 1 R, Murray Road, May 19, 1964, on road running through coniferous forest; FRBE 2 R, Freeland, May 30, 1964, on road in farmland; FRBE 52 R, Murray Road, August 23, 1964, on road in coniferous forest; FRBE 53 R, Tyne Valley, September 10, 1964, in dry ditch bordering farmland; FRBE 58 R, East Bideford, September 26, 1964, on road bordering an area of mixed woodland and peat bog.

Opheodrys vernalis vernalis: Four specimens of the Smooth Green Snake were collected, one of these being a female with eggs. Several other specimens were observed. The species is evidently fairly common in this area. Specimens: FRBE 50 R, (female which laid eggs shortly after capture), Murray Road, July 15, 1964, on road in coniferous woodland; FRBE 59 to 61 R, Murray Road, September 27, 1964, in trench cut for drain which served as a pit trap in an area of mixed, open woodland.

MARTIN L. H. THOMAS
Fisheries Research Board of Canada
Biological Sub-Station
Ellerslie, P.E.I.
5 January 1965

Breeding of the Mockingbird, *Mimus polyglottos*, in Newfoundland

THE WINTER OF 1963-1964 was very severe in eastern Newfoundland. Starting early in December, blizzard followed blizzard with abnormally low temperatures and snow accumulated until the end of March.

My residence in the city of St. John's is set back on a hill about 200 feet from a busy street. It is surrounded by large conifer and deciduous trees. For some years I have maintained a feeding station for birds under the trees about 20 feet from my front windows and from November until mid-May I keep the feeder supplied with bread crumbs, suet and wild bird seed. By December 1963, Slate-colored Juncos, Black-capped Chickadees, Evening Grosbeaks, House Sparrows, Starlings and the occasional Purple Finch were using the feeder with fair regularity.

On the afternoon of January 15, 1964 following an unusually severe blizzard when winds gusted up to 80 m.p.h., I noticed in the feeder a bird which at first appearance resembled an over-sized junco. This bird successfully drove off any others that tried to use the feeder and in the space of a few hours had taken firm possession of it. One of the distinctive features of this bird was that its long tail was held semi-erect while it was perching and was continually moving in short sharp jerks as it moved its head or changed its position. When the bird was first seen in flight, the startling irregular white patches under the wings and the

wide band down each side of the tail became strikingly apparent. The general impression which the bird gave in flight was that of a Gray Jay or a shrike.

The temperature was consistently 10° to 20°F and the bird kept its feathers fluffed out as a protection against the cold. It was not until nearly two months later that we were to see the bird with its feathers in their natural position, giving it its normal slim appearance.

A diligent search through our numerous bird books finally narrowed down the identification of our visitor and we were able to determine with certainty that we were hosts to a Mockingbird, *Mimus polyglottos*. As time passed we sought to find means of varying the Mockingbird's diet. It had subsisted on bread crumbs and suet until finally, by trial and error, we found that it was partial to raw apples. Once we discovered this, it ate an apple a day, presented to it in half sections.

After about a week, we found that the Mockingbird roosted at night in a dense fir close to the feeder. It was invariably the last bird to be seen on the wing each night, and it came regularly to the feeder for its evening snack of bread, suet and apple. In order to photograph the Mockingbird at closer quarters, I put another feeding tray against our kitchen window where the light was better and where our house sheltered the feeder from northerly winds. This temporary feeder soon became its favourite and we were able to study it at very close range.

The mockingbird remained around our house until April 12 and then disappeared for ten days. It returned on April 22 during a late severe snow storm and we saw it daily until May 13. From that date until it abandoned our feeder on May 31, we saw it only intermittently.

The Mockingbird had not sung while it was attending our feeder but would always greet us with loud chirping as we came to and from the house. On July 5 I heard a bird singing and sections of the song were like my Audubon Society recording of the song of the Mockingbird. The singer was in a grove of trees about a quarter of a mile away across a valley and as I approached it, I was delighted to recognize a Mockingbird. The bird continued to sing in our neighbourhood every day. On July 10 I was able to watch it at closer range as it sang from a television aerial about six houses up the street from me. I timed it on this occasion and it sang without interruption for just over ten minutes and imitated the songs of Bobolink, chickadee, robin and crow as well as those of other birds which I did not recognize. Between each different phrase it fluttered in the air about six inches above its perch and then settled and sang again.

On July 11 while watching one of those performances, my wife observed another Mockingbird in the trees close by. This was our first indication of a second Mockingbird. No singing was heard after July 14. On July 15, our neighbour, Mr. C. F. Horwood, 117 Rennies Mill Road, reported that a pair of Mockingbirds were nesting in a last year's robin's nest in a pine tree near his house. The two birds were observed regularly taking turns sitting on the nest and on August 6 both were observed carrying food to the nest. The visible food was almost invariably crane flies (*Phaenicia serricata*). Every precaution was taken that the chicks were not disturbed and on August 10 they were large enough for their yellow beaks to show as they were being fed. On August 16, they left the nest and it was examined for the first time. There was one unhatched egg remaining and it was given to Mr. Leslie M. Tuck who in preparing it found a dead embryo in the egg.

On August 18 one of the adults was observed on a telephone wire near the nest with three young ones which were scarcely half grown, but apparently able to flutter short distances. The other adult was near by on the ground under some shrubbery. On succeeding days it became evident that the parents had their brood on the ground near the nest and were bringing food to them there. Both parents

were seen carrying food until August 20. On that day, the single young one closely observed was nearly fully feathered and could fly short distances. The parents at that time watched alertly, one at housetop level and the other on the shrubbery. On August 24, I observed both adults and one young bird now fully feathered. The adults gave no indication that other young birds were anywhere near. The last observation of Mockingbirds in our neighbourhood for the summer was on August 28.

As far as I can determine from the literature this is the most northeasterly breeding record of the Mockingbird. We had the impression that there were four chicks in the nest in which case the clutch was five eggs. We only saw three fledglings at one time, however, and observations seemed to indicate that only one of those survived to the flying stage. Photographs were submitted to Mr. W. Earl Godfrey for confirmation of this record. This breeding record is not the first occurrence of Mockingbirds in Newfoundland. Mr. Leslie M. Tuck has well documented accounts of single Mockingbirds being previously recorded by Mr. Melvin McNeill at St. Anthony, November 10-13, 1956 where it fed on berries of Mountain Ash (*Sorbus americanus*); at Caribou Lake, Noel Paul River drainage, by Mr. Henrick Deichmann on October 24, 1961, and at Ramea by Mrs. H. J. Reid on October 31, 1963, and May 31 and October 18 and 23, 1964.

On November 15, 1964 a single Mockingbird was again observed in my back garden. Scattered snow was falling and we thought our previous visitor had returned for another winter but we had no further observations until December 13, when again a Mockingbird was using our feeder. This bird used the same perches and roost as our previous winter's visitor and most likely is the same bird.

H. DARROCH MACGILLIVRAY

93 Rennies Mill Road
St. John's, Newfoundland
6 January 1965

Unusual Behaviour in Gray Jays

SIX or seven years ago, while driving along the highway, I noticed a Gray Jay, *Perisoreus canadensis*, which flew across the road, perhaps a hundred feet ahead of the car, and which appeared to be carrying a whitish object several inches in diameter in its "talons."

When I mentioned this to a professional ornithologist, he expressed considerable surprise and suggested that the jay's feet had become entangled in cotton wool or something similar, as this behaviour would hardly be expected in Passerines, or in fact, any species other than the hawks, owls, and their relatives.

There the matter rested. Some time later I was able to observe another case of the same behaviour, on this occasion under much more favourable conditions.

This time the jay had been feeding on a scrap-pile, and flew across the road just a few feet in front of the car. Clutched in its claws was the heel of a loaf of bread, and every detail could be easily seen.

If this behaviour is as rare as my ornithological friend has stated, it is odd that one observer should have encountered it twice within a few years.

CHARLES R. K. ALLEN

Nova Scotia Bird Society
c/o Nova Scotia Museum of Science
Spring Garden Road
Halifax, Nova Scotia
15 February 1965

Seaside Sparrow, *Ammospiza maritima*, in Nova Scotia

FEBRUARY 21, 1962, turned out to be a "sparrow day" in the Cole Harbour-Chezzetcook area. The weather was mild — well above freezing — after nearly a week of temperatures in the 10°F to 5°F range, the ground was nearly free of snow and small land birds were rather more numerous than usual for this time of year.

Already listed by Dr. L. B. Macpherson and the writer in our day books were: 4 Savannah Sparrows, 3 Vesper Sparrows, 21 Juncos, 6 Tree Sparrows, 15 White-throats, 3 Fox Sparrows, 2 Swamp Sparrows, 16 Song Sparrows, and we had just topped this with a surprising Sharp-tailed Sparrow in the Lawrencetown marsh when, a few minutes later, on a nearby grassy slope, we spotted what appeared to be a larger darker member of this same species.

A second and closer look revealed, however, that this was a bird neither of us had ever seen before. The Field Guide was called into consultation and for once our bird sat reasonably still while we went through the process of elimination and came up with the startling conclusion that here was a Seaside Sparrow, *Ammospiza maritima* – a 'first' for us and, as it turned out, a 'first' for Canada.

This called for a hurried trip to the city to pick up the seldom-used collecting gun. Luck was with us, for on our return, we found our bird had oblingingly stayed "put", and we were soon able to confirm our earlier identification.

This specimen was prepared as a study skin and forwarded to the National Museum of Canada at Ottawa where it was positively identified as a Seaside Sparrow and placed in their collection as the first record of this species for Canada.

This experience was a perfect example of the value of what Peterson calls the "second look". Had it not been for this "second look", our Seaside Sparrow would have gone down in the daily list, simply as Sharp-tailed Sparrow Number 2.

CHARLES R. K. ALLEN

Nova Scotia Bird Society
c/o Nova Scotia Museum of Science
Spring Garden Road
Halifax, Nova Scotia
15 February 1965

A Sight Record of Gull-billed Terns in Nova Scotia

ON AUGUST 2, 1963, Dr. L. B. Macpherson and the writer observed two Gull-billed Terns, *Gelochelidon nilotica*, at West Lawrencetown Beach, Halifax County, Nova Scotia.

The birds were resting on a sand-bar in a 'diverticulum' of the Lawrencetown River surrounded by salt marsh, and behind the beach proper.

Arctic and Common Terns, both adult and immature, were present on the same bar, and provided an excellent chance for comparison.

The birds were studied for about an hour at a distance of approximately 150 yards through 20X and 40X telescopes, and the following points noted:

(a) somewhat greater length and stouter build than Arctic or Common Terns;

(b) entirely black beak, slightly shorter and stouter proportionately than those of the common species;

(c) legs and feet black, and legs apparently somewhat longer, as these two birds stood higher than the Arctics and Commons;

(d) when flushed the tail appeared fan-shaped or, in some positions, notched;

(e) when on the wing these two birds joined the adults of the other species in "mobbing" the observers, and during the process uttered a call quite unlike that of Common, Arctic or Roseate Terns – a three-syllable "kek-kek-kek" – rather sharp and piercing and somewhat nasal in quality;

(f) the upper wing surface and back were definitely paler than the plumage of the other two species;

(g) when feeding, the adult bird behaved in the manner described for Gull-billed Terns by Pough, flying low over the water and

apparently picking something from the surface or just below.

At first an honest attempt was made to identify these two birds as Roseate Terns, but this failed because of the shape of the tail, size, color of the feet and legs, and the voice.

The plumage was identical in both birds except for their caps; in one this was uniformly black, but in the other it presented a stippled appearance as in the winter plumage of the Caspian Tern. This latter bird showed juvenile characteristics in its behaviour, making begging motions with upraised wings and open beak as it followed the adult about over the sand. Furthermore, it took no part in the feeding forays of the adult bird but remained on the sand-bar until flushed.

Three other members of the Nova Scotia Bird Society observed these terns later on the same day and confirmed the identification.

This seems to be the first sight record of Gull-billed Terns for Nova Scotia, and the only other record for Canada that could be found was in Macoun's "Catalogue of Canadian Birds", (1909, Canada Department of Mines, Ottawa). This record was of a bird shot at Grand Manan, New Brunswick, in August, but the year given by Macoun, 1897, is erroneous. The correct year, 1879, is recorded by Ruthven Deane (1880, Bulletin Nuttall Ornithological Club 5(1): 63).

CHARLES R. K. ALLEN

Nova Scotia Bird Society
c/o Nova Scotia Museum of Science
Spring Garden Road
Halifax, Nova Scotia
15 February 1965

Dicranella crispa, a Moss New to Eastern Canada

Dicranella crispa (Hedw.) Schimp., one of the most distinctive species of a difficult and troublesome genus, is easily recognized by its delicate stature, leaves abruptly narrowed from a sheathing base to a spreading subula, and capsules erect and symmetric, becoming deeply furrowed and obconic when dry and empty. It grows as a pioneer on disturbed, sandy or clayey banks of roads, drainage ditches, or streams where it is often associated with *Pohlia proligera* (Hedw.) Lindb., a similarly rare or generally overlooked species.

The range given in Grout's *Moss Flora of North America* (1936, vol. 1, p. 58) is "Montana and Idaho to the Arctic," and Brotherus (1924, in *Die näturlichen Pflanzenfamilien*, ed. 2, vol. 10, p. 177) attributes the species to North America, northern and central Europe, and Siberia. On the basis of specimens in the herbarium of the National Museum of Canada I can confirm the range, as follows: Europe (Norway, Finland, Sweden, Denmark, Germany, Ireland, and Scotland); Greenland; North America (arctic and southeastern Alaska, Yukon, Great Bear Lake, British Columbia, Alberta, northwestern Manitoba, Oregon, Idaho, Montana, and Wyoming). The species can now be recorded from eastern Canada on the basis of two recent collections in Labrador: On sandy soil, about 3 miles up Traverspine River, Goose Bay, *W. B. Schofield* 708, Aug. 10, 1949 (DAO, CAN); Cape Caribou, Grand Lake, *P. Kallio*, July 18, 1963 (CAN).

The following exsiccati specimens can be cited as authentic examples of the species: Grout's *North American Musci Perfecti* 138; Drummond's *Musci Americani* (*Rocky Mountains*) 101 (as *Dicranum*); Holzinger's *Musci Acrocarpi Boreali-Americani et Europaei* 587; Macoun's *Canadian Musci* 501; Renauld & Cardot's *Musci Americae Septentrionalis* 356; *Musci Leibergiani* 69.

HOWARD CRUM

National Museum of Canada
Ottawa, Ontario
5 March 1964

Recent Additions to the List of Jasper National Park Birds

THE FOLLOWING new bird records for Jasper National Park, Alberta, were secured while I was engaged in wildlife investigations in that region for the University of Alberta, Edmonton. For the most part these field inquiries were carried out at various times from mid-May until early September during the seasons of 1960 to 1963, inclusive. All specimens taken during those years were deposited in the permanent research series of the U. of A., Museum of Zoology.

Ereunetes pusillus (Linnaeus).
SEMIPALMATED SANDPIPER.

This species was tentatively listed by I. McT. Cowan in his report, "Birds of Jasper National Park, Alberta, Canada" (Canadian Wildlife Service Bulletin 2, No. 8, June 1955). He saw large flocks of small sandpipers flying southward over the alplands near Cairn Pass on August 3, 1943, that he provisionally referred to *pusillus*. I am now in a position to provide a positive record of occurrence. On August 14, 1962, a small flock of about a dozen little sandpipers was seen feeding on a muddy flat along Athabasca River a little west of the mouth of Fiddle Creek. An effort was made to take a specimen for unquestionable identification, but at the time apparently failed. Two days later, however, a partly decomposed individual was discovered farther east on the same flat that had doubtless fallen from the flock mentioned; it proved to be an example of this species.

Stellula calliope (Gould). CALLIOPE
HUMMINGBIRD.

During the week spent on investigations near the forks of Derr Creek and Miette River, June 16 to 22, 1960, two of these hummingbirds were personally observed and the male (No. 6109) collected on June 21. Until very recently this specimen was thought to have been the first *calliope* ever taken, or observed in Jasper Park. In this supposition, however, I was mistaken.

Through the kindness of Mr. Earl Godfrey a very thorough check was made for unpublished records in the National Museum of Canada. This bore results. In a letter of February 25, 1965, he remarked: ". . . Our 12591, a female, taken in Jasper Park, June 26, 1918, by Wm. Spreadborough and until now misidentified and catalogued as *Selasphorus rufus* and placed with them in the collection is, I find, *Stellula calliope*. It has never been recorded."

Again, during the last week of June, 1960, I several times saw a pair of these hummingbirds at Ranger Creek where the male (No. 6155) was collected on June 28. By their actions, the birds seemed to be summer residents of that locality and ostensibly breeding, but the nest, if any, was not discovered. As will be noted, the occurrence of the species in Jasper Park is now supported by three specimens. Nothing was seen of *calliope* in the three succeeding seasons of bird observations in the park.

Sphyrapicus varius (Linnaeus).
YELLOW-BELLIED SAPSUCKER.

A pair was observed at Derr Creek on June 21, 1960, and the male (No. 6110) collected. Another male was seen on June 28, 1961, along Miette River between Jasper and Wynd; it was the only individual detected that summer. Nothing was seen of *varius* in 1962 nor 1963.

Vireo solitarius (Wilson). SOLITARY
VIREO.

During many periods of park investigations in past years this species was never seen and thus appeared to be quite rare, or absent in this region. At last, however, on May 21, 1963, a singing male (No. 7176) was collected at The Palisades and on May 24 another was seen and heard singing in the same locality. In view of all the ornithological

inquiries so far conducted in the park with such meagre results, *solitarius* may be rightly regarded as very scarce and of highly localized occurrence.

J. DEWEY SOPER

Museum of Zoology
University of Alberta
Edmonton, Alberta
20 April 1965

Additional Bird Species Recorded in Waterton Lakes National Park, Alberta

MOST of the following additions to the known avifauna of Waterton Lakes National Park were secured by the writer while engaged in field research there at various times in June, July, and August from 1960 to 1963, inclusive. The investigations were conducted under authority of a special permit for the University of Alberta, Edmonton; all specimens collected were placed in the permanent ornithological series of the Museum of Zoology.

I am indebted to Mr. Earl Godfrey, Curator of Ornithology, National Museum of Canada, for several park records by C. H. Young which were not included by A. L. Rand (1948, *Birds of Southern Alberta*, National Museum of Canada, Bulletin 111). Mr. Godfrey has also kindly provided two "firsts" of his own—that of the Least Flycatcher and Rock Wren, records not previously published.

Olor buccinator Richardson. TRUMPETER SWAN.

A very large swan seen feeding in a quiet backwater near the north end of Maskinonge Lake on July 6, 1963, was considered as almost certainly an example of this species. The geographical location and especially the mid-summer date of occurrence would seem to lend very substantial support to the foregoing conclusion.

Larus californicus Lawrence. CALIFORNIA GULL.

A solitary gull of this species was carefully studied at close range on a pond at Indian Springs on June 21 and 22, 1962. The following week several gulls seen flying over the lake north of Dardanells also appeared referable to this species. In 1922, Young recorded both this species and Ring-billed Gulls in the park, but queries showed that he was not always sure of individual identity. We know now that he could have been correct in connection with some listings of California Gulls; with reference to them in his manuscript summary notes he remarked: "A few in May and fairly common in August and September. They came from the north and passed south."

Coccyzus erythropthalmus (Wilson). BLACK-BILLED CUCKOO.

On June 19 and 20, 1962, the unmistakable, peculiarly guttural notes of one of these birds were heard on several occasions in poplar woods along Waterton River near the northeastern boundary of the park. Another cuckoo was heard calling in aspen woods near Indian Springs on June 21 of the same season. The species was not detected elsewhere in the park.

Picoides arcticus (Swainson). BLACK-BACKED THREE-TOED WOODPECKER.

Encountered only once in the Waterton area. A fine male was examined at close range with the glasses on July 25, 1960, along the trail between Twin Lakes Cabin and Lost Lake. Extreme summer scarcity, at least, is suggested by the fact that during the next three seasons the species was nowhere encountered.

Empidonax traillii (Audubon). TRAILL'S FLYCATCHER.

Several were heard calling in characteristic fashion at Cottonwood Creek (Oil Basin) between June 21 and 28,

1963. A male (No. 7254) was collected there on June 26 and another heard "singing" higher up the creek on the following day. In a letter of December 29, 1964, Mr. Godfrey remarks: "Stein (1963, Proceedings of the American Philosophical Society, 107 (1): 22-50) regards *Empidonax traillii* and *E. brewsteri* as separate species, a view that requires additional investigation. Regardless of this, your Waterton specimen is unquestionably referable to *E. traillii* (not *brewsteri*). Doubtless this was a breeding individual judging by the date and condition of the gonads. Thus it shows that *traillii* breeds south at least as far as extreme southwestern Alberta."

Empidonax minimus (Baird and Baird). LEAST FLYCATCHER.

On July 9, 1956, Mr. Earl Godfrey saw one of these birds in balsam poplars bordering a small pond beside the Red Rocky Canyon road. It was still "singing" its unmistakable notes at this time.

Tachycineta thalassina (Swainson). VIOLET-GREEN SWALLOW.

Between July 29 and August 2, 1960, I saw several of these swallows at Belly River near the International Boundary. They were usually flying in pursuit of insects over the water and neighbouring grasslands. This was the only locality in which the species was met with. I failed to see the birds anywhere in the park during the summers of 1961, 1962, or 1963.

Petrochelidon pyrrhonota (Vieillot). CLIFF SWALLOW.

Mr. Godfrey told me that at Waterton Park, in 1922, C. H. Young observed six Cliff Swallows on June 22; ten on June 23; one on July 11; and fifty on August 5. My own impression rated the birds as very scarce in this region, as I failed to detect them anywhere in the park from 1960 to 1962. On June 28, 1963, however, a pair was seen flying about near the mouth of Carthew Creek at the Waterton Lakes townsite; they were not seen again.

Parus hudsonicus Forster. BOREAL CHICKADEE.

Hudsonicus was first noted on July 24, 1960, in the high country (5,600-6,500') around Lost Lake and the forks of Lost Lake Creek and upper Bauerman Brook. Then several were observed during the next few days along the trails to Lost and Twin Lakes. A male (No. 6242) was taken in the latter locality on July 28, 1960. Except locally at the higher altitudes the species appears to be quite scarce.

Salpinctes obsoletus (Say). ROCK WREN.

Mr. Godfrey informed me that he observed a singing male in Waterton Park on July 9, 1956, where suitable nesting sites exist here and there in the way of rugged cliffs and rocky canyons. In this area, without question, the species is thinly dispersed and scarce. In Alberta its chief breeding range lies in scattered badlands of southeastern localities.

Sturnus vulgaris Linnaeus. STARLING.

A pair was observed inside the buffalo paddock near Indian Springs on June 21, 1962. Despite the great increase of these birds in Alberta during recent years, this is the first and only record for the area under review.

Vireo olivaceus (Linnaeus). RED-EYED VIREO.

Two singing males were observed in the park by Mr. Godfrey on July 9, 1956. On June 20, 1962, I came upon two different males in full song at Indian Springs where Transition Zone conditions exist. Two days later another was heard in poplar woods along the west side of Waterton River east of the buffalo paddock. Along Cottonwood Creek, at the Oil Basin, a singing male was recorded on June 27, 1963, and during the first week of July two or three others

were still singing in deciduous woods at Sofa Creek.

Pheucticus melanocephalus (Swainson). BLACK-HEADED GROSBEAK.

A male of this species was heard singing along upper Cottonwood Creek on June 24 and 25, 1963. On the following day I collected one near the creek in rank, jungle-like woods of poplar and dense shrubbery; this is a male (No. 7253) which had fully developed testes and was doubtless breeding where found. Another beautiful male (No. 7290) was taken at Sofa Creek on July 3, 1963. It was inhabiting thick aspen poplar woods with tangled underbrush bearing close resemblance to Transition Zone conditions, although heavy mixedwood forest existed in the same locality.

Pinicola enucleator (Linnaeus). PINE GROSBEAK.

These birds were very sparingly distributed in the high altitude coniferous forest at and between Lost and Twin Lakes during my stay there from July 23 to 29, 1960. On some dates the species was not observed. A male (No. 6232) was collected on July 26 near the forks of Lost Lake Creek and Bauerman Brook at an altitude of about 6,200 feet.

Loxia curvirostra Linnaeus. RED CROSSBILL.

Mr. Godfrey has provided a record to the effect that C. H. Young saw two of these birds, somewhere in Waterton Park, on September 2, 1922. Individuals, pairs and small companies of these crossbills occurred irregularly along upper Bauerman Brook and at Lost Lake from July 24 to 28, 1960. On the latter date I took a male (No. 6243) at Twin Lakes (6,500') where small bands were feeding in the tops of conifers near timberline. A few others were encountered near Sage Pass.

J. DEWEY SOPER

Museum of Zoology
University of Alberta
Edmonton, Alberta
20 April 1965

Some Summer and Migration Observations on Whistling Swans in Manitoba

DURING 1963 and 1964 I obtained some summer and fall arrival records for Whistling Swans (*Olor columbianus*) in Manitoba. These observations were made while I was conducting periodic aerial counts of diving ducks on some large lakes in the west-central part of the province.

On August 13, 1963, I saw a single adult swan (assumed to be a Whistling Swan) at the northern end of Dauphin Lake (51°20′ N., 99°40′ W.). No swans were seen during three previous flights (June 13, July 6 and 29); but during the flight of May 22, a total of 207 birds were counted on all of the lakes included within the survey. Because Dauphin Lake is large and my survey covered only a portion of it, the birds may have been unobserved during the earlier flights. Therefore, it would be only speculation for me to say whether this August record involved an early migrant or an injured bird.

On June 11, 1964, I observed a pair of swans appropriately located on Swan Lake (52°30′ N., 100°40′ W.) near the delta formed by the Swan River. A pair of swans, among the six seen on this lake, had been observed at this same location on the previous flight of May 19. Again at this location, a pair of swans was observed on July 5 and 19.

Following the aerial survey on July 19, I traveled by boat down the Swan River to its outlet in Swan Lake where both swans were found. Because of shallow water and dense aquatic vegetation one of the swans could not be overtaken. The other swan, however, was approached to within 50 feet. This bird, which had a broken wing, was identified by its yellow lores as a Whistling Swan. Neither bird vocalized. It is assumed that this June-July record of adult swans represented paired birds – the first bird remaining with its injured mate. No

swans were seen on this lake during flights on July 27 and August 12.

H. Albert Hochbaum (personal communication) writes that during 1964 at the Delta Marsh (50°10′N. 98°10′W.) at least three swans remained through June and one was seen during July. The swan observed during July came regularly into the Delta Waterfowl Research Station's pond. Hochbaum feels that this bird must have molted on the marsh.

Bent (1925, *Life Histories of North American Wild Fowl*, p. 293) reports the earliest arrival date for Whistling Swans at Shoal Lake, Manitoba, as April 30. In Saskatchewan, Houston and Street (1959, *The Birds of the Saskatchewan River*, p. 39-40) list earliest spring arrivals as April 21, in the Prince Albert region, and April 6, in the Nipawin region. On April 29, I counted 655 swans in the narrow bands of open water found along Swan Lake's southern shore. This was the northernmost lake examined during the flight because we did not expect to find open water to the north. From 1939 to 1963 (1949 and 1950 excluded), the average date of arrival for Whistling Swans on the southern shore of Lake Manitoba (50°20′ N., 98°20′ W.) is April 10 (S.E.=1.6 days; S.D.= 7.5 days; N=23 years), with extremes of March 23 and April 20. I wish to thank H. A. Hochbaum, Director of the Delta Waterfowl Research Station, for making available the station's records from which these dates were determined.

For the fall migration of Whistling Swans Bent (1925, p. 293) reports some early dates of arrival as: Mackenzie region, Great Bear Lake, September 15, and Mackenzie River, October 6; and Quebec, St. Ignace, October 11. Houston and Street (1959, p. 40) note that fall arrivals are not observed until mid-October in the Nipawin region of Saskatchewan. Synder (1957, *Arctic Birds of Canada*, p. 43) says that their departure from the breeding grounds begins in late August and is generally completed by late September. H. A. Hochbaum (personal communication) says that they are not conspicuous on the Delta Marsh until late October or early November. On September 5, 1964 I observed three adult swans on Swan Lake and two adult swans on Spence Lake (51°30′ N., 99°30′ W.). It is possible that two of the three birds on Swan Lake were the pair seen throughout much of the summer, but the two birds on Spence Lake were definitely new arrivals. On September 20, 1964, 30 swans were observed on Spence Lake. Both observations of swans (September 5 and 20) constitute records for early arrivals at this relatively southern latitude.

I believe that an occasional "misplaced" swan may go unnoticed by some of the more experienced observers because, at a distance, it may be easily mistaken for one of the ubiquitous White Pelicans (*Pelecanus erythrorhynchos*).

JAMES C. BARTONEK

University of Wisconsin
Department of Wildlife Management
Madison, Wisconsin 53706
23 April 1965

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JOHN RICHARDSON DYMOND

October 4, 1887 – January 31, 1965.

W. BEVERLEY SCOTT
Royal Ontario Museum, University of Toronto, Toronto 5, Ontario

ONE of Canada's best known zoologists, Professor Emeritus at the University of Toronto and key figure in the conservation movement in Canada, J. R. Dymond, known to friends and colleagues simply as "J. R.", died suddenly of a heart attack in Toronto, January 31 at the age of 77. His name will find an honoured place in the history of science in Canada.

Few Canadian zoologists have served their country so ably and in so many roles. In addition to his primary position as a teaching professor, he served as president or senior officer of a number of national and international scientific organizations. For example, he was Director of the Royal Ontario Museum of Zoology, member (and Vice-Chairman for six years) of the Fisheries Research Board of Canada, was an active member of international commissions, played a major part in the formation of the Federation of Ontario Naturalists and worked most energetically and effectively for intelligent conservation measures of wildlife resources. In addition to all these activities he found time to publish over 100 scientific and popular papers and to pursue research in his favourite field of ichthyology.

The wonder is how he found the time to undertake such a bewildering array of responsibilities. "J.R." seemed to possess an awareness of responsibility to his community that is not common among today's professional men. It may well be that history will claim his most significant contribution to be his success in making Canadians aware of the need to conserve their natural resources, not the wildlife alone but the whole association of life, soil and water. On the other hand, it has been suggested that his greatest contribution may have been in his role as a professor on the staff of the University of Toronto, where he stimulated and guided zoology students, particularly in fisheries research. Certainly his interest in teaching was sincere and long-lasting. "J.R." commenced teaching in 1907 at the early age of 20 and continued to teach until his retirement from the University in 1956. During the summers of the later years of his University career, when not teaching formal courses at the University he carried on his work from his cottage at Smoke Lake, Algonquin Park, where graduate students, colleagues and friends would find him always available for counsel and advice.

In conversation during his so-called retirement years, he once remarked that perhaps his major contribution had been in teaching and administration

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rather than in ichthyology. He noted that although he almost always felt nervous before a class he did enjoy both teaching and administration. Indeed, there are few laboratories, universities or secretariats concerned with fisheries in Canada without staff members who have been exposed to his teaching. In a recent dedication to "J.R." that appeared in the Journal of the Fisheries Research Board, it was noted that "About 40 present members of the Board's staff have had this contact [with J. R. Dymond] whether as Major Professor, Department Head or simply as counsellor and friend." To emphasize this point we need only mention the names of a few former students such as Dr. J. L. Hart, Director, Biological Station, Fisheries Research Board of Canada, St. Andrews, New Brunswick; Dr. A. L. Pritchard, Director, Fish Cultural Development Branch, Department of Fisheries, Ottawa; Dr. W. A. Kennedy, Director, Biological Station, Fisheries Research Board of Canada, London, Ontario; Dr. C. H. D. Clarke, Chief, Fish and Wildlife Branch, Ontario Department of Lands and Forests, Toronto and Dr. H. E. Welch, Head, Department of Zoology, University of Manitoba, Winnipeg. It was a source of great sadness to him that some of his former students such as Drs. R. B. Miller and D. S. Rawson, themselves heads of university zoology departments, predeceased him. He valued deeply the friendships made with students and colleagues and for many years he and his wife annually entertained at tea in his former home at 205 Cottingham Street.

Considering his life-time interest in all aspects of natural history it seems appropriate that J. R. Dymond was born and raised on a farm in Metcalfe Township, Middlesex County, Ontario. He attended county schools and in 1906 graduated from Strathroy Collegiate. Teaching was attractive and in 1906 he attended Model School in Strathroy and then taught public school in Caradoc Township in 1907 and 1908. In the fall of 1908 he entered Victoria College, University of Toronto, graduating in 1912 with a Bachelor of Arts degree. He was also awarded the Victoria College Gold Medal in Natural Science.

After graduation he took a position with the Department of Agriculture, Ottawa and as a seed analyst, worked successively in Ottawa, Calgary and Winnipeg. On June 16, 1915, he married Hilda Mary Freeman, of Ottawa.

In 1920 having re-entered the University of Toronto for post graduate training he obtained his M.A. degree and that same year became a Lecturer in Systematic Zoology on the staff of the Department of Biology. The following year, 1921, his only son, William Richard, was born.

Commencing in 1921, many weeks of each of the next fifteen years were spent in faunal survey (especially fishery) work in the field, usually accompanied by his wife and small son. He worked, successively, at Lake Nipigon, Lake Abitibi, British Columbia, Lake Ontario, Lake Nipissing and Algonquin Park. Field studies were never entirely abandoned and in later years he worked at Lake Erie and at Lake of the Woods, but after the mid 1930's he did not engage in fishery field work for prolonged periods. This period of active field work was also a productive period for publication, and over half of his published papers appeared during this time.

J. R. Dymond on the occasion of his resignation as Director, Royal Ontario Museum of Zoology, 1949.

Opportunities to employ his administrative talents began to appear and in 1922 he began his long association with the Royal Ontario Museum, becoming Secretary to the Royal Ontario Museum of Zoology in 1922, Assistant Director in 1931 and Director in 1934. This latter position he held until 1949. In 1961 he was appointed Honorary Curator of Ichthyology.

Dr. Dymond was an active, working member of a number of societies and organizations and seldom joined an organization without volunteering to work in its interests. He was one of the founding members of the Brodie Club, and at one of its meetings in 1931 made the proposal that led to the formation of the Federation of Ontario Naturalists that same year. He was Honorary Secretary to the Federation from 1936 to 1947 and from 1950 to 1955, and President from 1955 to 1959. He was also active in the affairs of the Toronto Anglers' Association and also the Ontario Federation of Anglers, later to become the Ontario Federation of Anglers and Hunters. Among the societies in which he took an active part were the following: American Association for the Advancement of Science (Member 1921, Fellow 1931), Toronto Field-Naturalists' Club (President 1929-1931), Royal Canadian Institute (President 1939-1940, 1956-1957, Member of Council 1934-1937, 1940-1943), National Association of Audubon Societies (Director 1938), American Society of Ichthyologists and Herpetologists (Vice-President, President 1939-1942), Fisheries Research Board of Canada (Member 1938-1958, Vice Chairman 1947 to 1953) and International Commission on Zoological Nomenclature (Member 1939-1961), Director, Ontario Federation of Commercial Fishermen (later Ontario Council of Commercial Fisheries) 1946 to 1965, and member, Conservation Council of Ontario 1952 to 1965. He was for years a devoted member and respected Elder of Timothy Eaton Memorial Church in Toronto.

"J.R." maintained a special interest in the Ottawa Field-Naturalists' Club and was an early contributor to the Canadian Field-Naturalist. His first article to be printed in its pages appeared in 1918 and he continued to contribute throughout his life. Of the 125 scientific and popular papers in his bibliography, 24 were published in the Canadian Field-Naturalist. From 1940 until his death 25 years later, he served as an associate editor (ichthyology).

In 1947 he became Chairman of the Advisory Committee on Fisheries and Wildlife Research of the Ontario Research Commission and the Research Council of Ontario, and later (after 1954) of the Ontario Research Foundation and retained this responsible position until 1964. In 1948 he became Head of the Department of Zoology, University of Toronto, a position he held until retirement in 1956. Although he continued to make significant contributions to professional organizations, University affairs required most of his time and energy during this period.

Dr. Dymond's contributions to science and education did not go unnoticed by Canadians. In 1938 he was made a Fellow of the Royal Society of Canada. For his many volunteer services to the government during the war years he was cited in the King's Honour List of July, 1946, being named an Officer of the Order of the British Empire (O.B.E.). In 1950 he was awarded a Doctor of Science degree by the University of British Columbia.

J. R. Dymond and colleagues, (left to right), Professor A. F. Coventry, L. L. Snyder and Professor T. F. McIlwraith, in the Brodie Club Room, Royal Ontario Museum, fall 1955. (photograph courtesy of Ashley & Crippen, Toronto, Ontario)

The American Society of Ichthyologists and Herpetologists elected him the first Distinguished Fellow in 1961 and in 1962 he was awarded the Julian Crandall Award for his contributions to the advancement of Conservation in Canada.

When he retired from his university position in 1956, he remained as busy as always, and in 1957 became Consultant to the Ontario Department of Lands and Forests. In 1960 he was appointed a member of the Great Lakes Fishery Commission, one of the three Canadians on the Commission, and served actively until his death. And in 1961 he was appointed Honorary Curator of Ichthyology in the Royal Ontario Museum, an institution for which he had worked conscientiously and voluntarily for over 25 years. His manuscripts, field notes and other writings are retained, at his request, in the files of the Department of Ichthyology and Herpetology, Royal Ontario Museum.

To this point no specific mention has been made of Professor Dymond's writings, of which there were many. The appended bibliography points up his special interest in fishery research and conservation, but also shows the breadth of his interests. One of his last contributions to science was a history

of ichthyology in Canada, written for the American Society of Ichthyologists and Herpetologists. At the time of his death he was completing a comprehensive account of the Lake Ontario Atlantic salmon for the Ontario Department of Lands and Forests. The exploitation and eventual extinction of this fish during the nineteenth century was of special interest to him. Dr. H. H. MacKay has been engaged to complete this work for publication.

Throughout his life John Richardson Dymond laboured conscientiously and well in his special fields of science and education. A quiet and kindly man whose twinkling eyes revealed a keen sense of humour, "J.R." was one of the 'giants' of our times. He has left Canadians a rich and rare legacy.

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W. BEVERLEY SCOTT
Royal Ontario Museum, University of Toronto

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GROWTH OF YOUNG ATLANTIC SALMON, *SALMO SALAR*, IN THE GANDER RIVER SYSTEM, NEWFOUNDLAND

C. W. Andrews

Department of Biology, Memorial University of Newfoundland, St. John's Nfld.

Introduction

During June, July and August of 1951 most of the major tributaries of the Gander River (Figure 1), both above and below Gander Lake, were visited with a view, primarily, to reporting obstructions natural or otherwise, to ascending adult salmon. At the same time, limited opportunity was afforded to make small sample collections of young salmon from which scales and length measurements were taken. This paper is concerned with growth rates and is a result of a study of the field data thus obtained. No previous work on growth rates of the young of Atlantic salmon in the Gander River appears in the literature.

Materials and Methods

Each tributary, with the exception of tributaries on the South West Gander River, was visited by canoe. The South West Gander tributaries were reached by access roads through the courtesy of the Bowater's Pulp and Paper Company, Corner Brook, Newfoundland. A small handseine measuring about 3 ft. by 3 ft., leaded at the bottom and equipped with two wooden handles, was used for collection in all tributaries. The meshes of the seine measured 20 mm in length (stretched), thus underyearlings could pass through the seine, and only a few were taken.

Most of the seining was done at night between the hours of 10:30 p.m. and 2:00 a.m., when it seemed that better results could be obtained than in daylight when young salmon tended to seek cover and were therefore more difficult to locate. At night it seemed that the young salmon were not under cover but lay motionless in the open and in contact with the river bottom. Seining was done with the help of a Coleman gas lamp which was held by one fieldman while the other operated the handseine.

Usually, the area to be seined, varying from one quarter to one half mile of stream bed, was selected on the afternoon preceeding the night of seining. Stretches of the river regarded as favourable for parr were selected and in general such areas had many similar physical characteristics especially with respect to bottom, width of stream, slope and depth of water.

Small samples of fish were taken at each of several points on the upper and lower parts of the Gander River (Figure 1). On the upper Gander these points were: South West Gander River at Camp 2, Camp 11, and Camp 13, and its tributary streams of Big Dead Wolf Brook at Camp 6 and Camp 11, and Little Dead Wolf Brook; on the North West Gander River at two miles

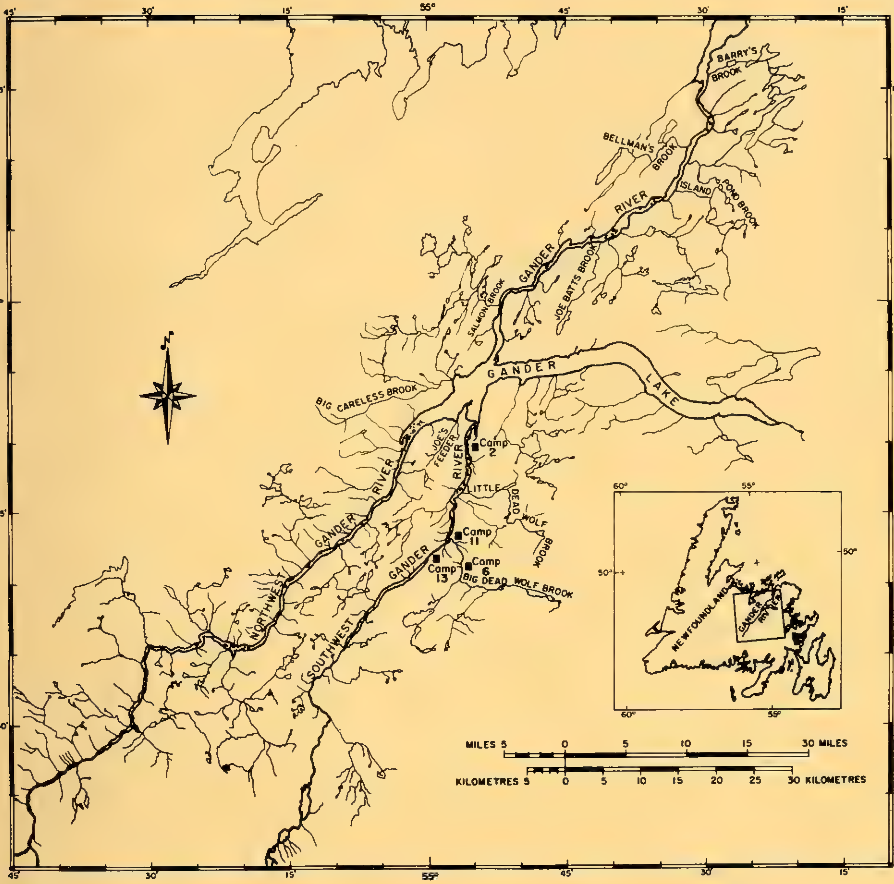

FIGURE 1. Locations on the Gander River system mentioned in the text.

above its mouth; small samples were also taken at Big Careless Brook and Joe's Feeder. On the lower Gander, samples were taken in the main river at First Pond and in the tributary streams of Barry's Brook, Bellman's Brook, Joe Batt's Brook, Island Pond Brook, and Salmon Brook. All fish from tributary streams were seined in the first mile or two and samples ranging from 15 to 54 in number were taken at the various points seined. A total of 218 young salmon were collected in the lower Gander and 342 in the upper Gander.

RESULTS

Availability of Parr

A crude measure of availability or density of parr may be obtained if the time spent in actual seining operation and the number of parr caught are known. This is tabulated for night seining in Table 1. The highest density occurred in the South West Gander River at Camp 11 where the average time

TABLE 1. — Availability of parr in various areas of the Gander River System

Location	Time	Minutes	No. parr taken	Average time to catch one parr	Date 1951
S.W. Gander at Camp 11	11:00 p.m. — 1:00 a.m.	120	50	2.4	July 18
Joe's Feeder	10:45 — 11:50 p.m.	65	24	2.7	Aug. 1
Big Careless Brook	9:50 — 11:20 p.m.	90	32	2.8	July 19
Big Dead Wolf Brook	10:30 p.m. — 1:00 a.m.	150	51	2.9	July 16
S.W. Gander River at Camp 2	11:00 p.m. — 12:10 a.m.	70	20	3.5	July 17
Salmon Brook	11:00 p.m. — 1:30 a.m.	150	36	4.2	July 27
Salmon Brook	10:30 p.m. — 2:00 a.m.	210	50	4.2	July 19
N.W. Gander River at 2 miles	10:50 p.m. — 11:55 p.m.	65	13	5.0	Aug. 2

spent to catch one parr was 2.3 minutes. Additional time indicating lower density was spent per parr caught at each of the other points listed in the table, with North West Gander at 2 miles having the lowest density — 5.0 minutes, to catch 1 parr.

Length Composition

A total of 218 young salmon were collected in the lower Gander, and 348 were taken in the upper Gander chiefly in the South West Gander River and its tributaries. In the upper Gander the mean fork length of fresh specimens was 91.9 mm (Table 2 and Figure 2) while for some other tributaries flowing into the western part of Gander Lake — North West River at 2 miles, Joe's Feeder, and Big Careless Brook, the mean length for the combined sample was 69.0 mm. The total sample for the latter tributaries, however, was only 68 fish and was probably not representative of the area.

In the lower Gander the mean length was 101.4 mm. Barry's Brook, the first tributary on the lower Gander was found to contain several obstructions in the form of impassable dams, gates, sluices, and log jams, especially in its lower two miles. No fish of 90 mm or less were taken in Barry's Brook whereas 19 fish were taken at lengths between 140 and 229 mm. Absence of fish of 90 mm in length and less would seem to indicate failure of adult salmon

TABLE 2.—Percentage length composition of complete samples, July–August, 1951. Sample size in parentheses.

Length Group (mm)	(a) Upper Gander		(b) Lower Gander	
	S.W. Gander and its tributaries	Gander Lake tributaries, S.W. Gander excluded	Barry's Brook excluded	Barry's Brook included
30 — 39	7.7(21)	27.9(19)		
40 — 49	1.5(4)	1.5(1)	1.2(2)	0.9(2)
50 — 59	0.7(2)	2.9(2)	1.2(2)	0.9(2)
60 — 69	6.6(18)	13.2(9)	14.6(25)	11.2(25)
70 — 79	8.4(23)	16.1(11)	9.9(17)	7.8(17)
80 — 89	17.9(49)	16.1(11)	17.5(30)	13.8(30)
90 — 99	23.7(65)	13.2(9)	19.3(33)	17.0(37)
100 — 109	15.7(43)	4.4(3)	20.5(35)	20.2(44)
110 — 119	10.9(30)	2.9(2)	8.8(15)	10.6(23)
120 — 129	2.6(7)	1.5(1)	3.5(6)	5.5(12)
130 — 139	0.7(2)		2.9(5)	2.8(6)
140 — 149	1.5(4)			3.2(7)
150 — 159	0.4(1)			0.9(2)
160 — 169				1.4(3)
170 — 179	0.4(1)			1.4(3)
180 — 189				
190 — 199				1.4(3)
200 — 209			0.6(1)	0.5(1)
210 — 219	0.4(1)			
220 — 229	0.7(2)			0.5(1)
230 — 239	0.4(1)			
Totals	100(274)	100(68)	100(171)	100(218)
Mean length	91.9	69.0	92.5	101.4
Standard deviation	29.0 mm	25.5 mm	20.86 mm	29.0 mm
Standard error	1.70 mm	3.09 mm	1.59 mm	1.90 mm

to ascend during the year or two previous to 1951 and the presence of the higher length classes of 140 to 229 mm to the failure of smolts to descend, giving rise to post-smolts, a situation not uncommon where river obstructions, including beaver dams, exist. Only three post-smolts were taken in the upper Gander – at Camp 13 on the South West Gander River, but no obstructions to descending salmon were observed in this area.

When the mean length of 91.9 mm for the South West Gander River and its tributaries (upper Gander) is compared with the mean length of 101.4 mm for the lower Gander River, including Barry's Brook, a significant difference in length is indicated ($P<0.05$). When, however, the Barry's Brook sample of 47 fish is excluded from the lower Gander sample the mean length is 92.5 mm which indicates no significant difference ($P>0.05$) between the combined South West Gander – upper Gander sample and the combined lower Gander River sample.

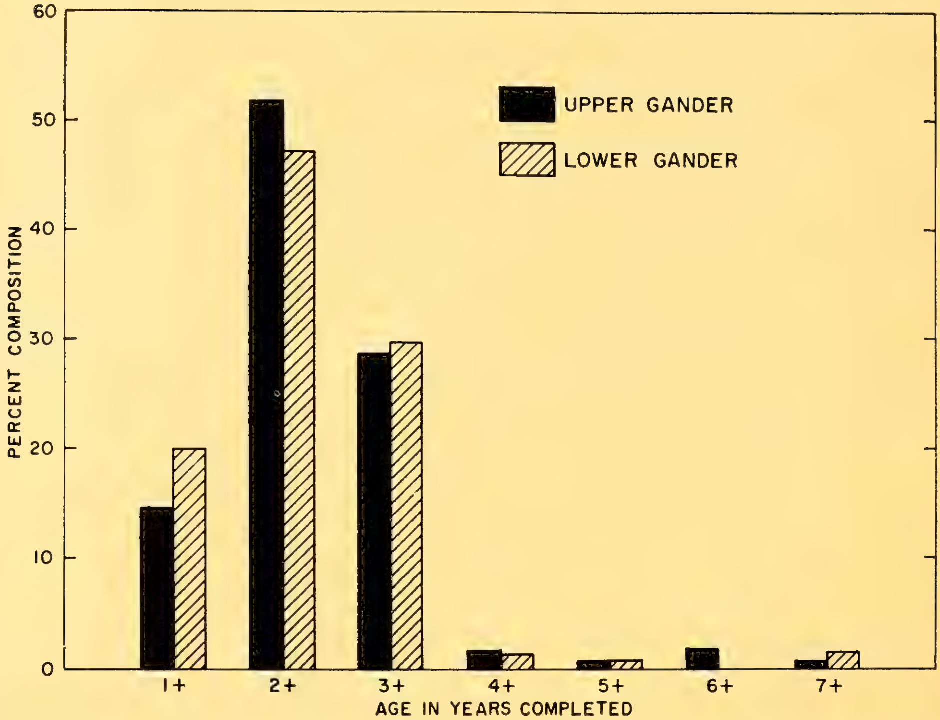

FIGURE 2. Length composition of young Atlantic salmon in the Gander River, summer, 1951.

Age Composition

Age composition of the upper and lower Gander River samples, Table 3 and Figure 3, show clearly the importance of the 2+ and 3+ year classes in the parr population. In the upper Gander, for example, 2+ and 3+ year-old parr made up 51.9 per cent and 28.8 per cent respectively of the sample, or a total of 80.7 per cent. The same year classes in the lower Gander (Barry's Brook excluded) constituted 47.1 per cent and 29.7 per cent respectively or a total of 76.8 per cent. Small percentages of 4+, 5+, 6+ and 7+ year-old fish were present in both areas; in the South West Gander (upper Gander) at Camp 13, 4 of the 15 young salmon taken were in the 5+, 6+ and 7+ year classes and 7 of the 44 fish taken in Barry's Brook (lower Gander) were 5+ years and older.

Age-length Relationship

Mean fork length for each age group in tributaries of the upper and lower Gander River, Table 4 and Figure 4, show only slight variation among year classes 1+, 2+, and 3+. At 1+ years, for example, the lengths were 71.3 mm for the upper and 68.6 for the lower Gander (excluding Barry's Brook) respectively; and for 3+ years 113.3 mm and 109.0 mm respectively. Wider

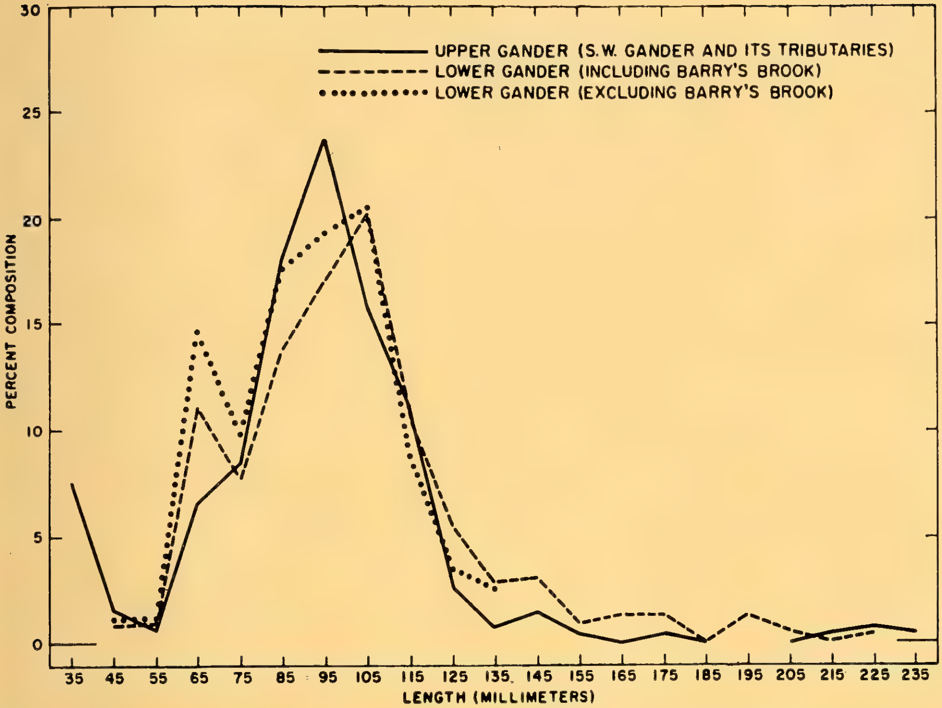

FIGURE 3. Age composition of young Atlantic salmon in the Gander River, summer, 1951.

TABLE 3. — Percentage age composition of complete samples, July–August, 1951. Sample size in parentheses

Location	Age in years completed							Total fish
	1+	2+	3+	4+	5+	6+	7+	
Upper Gander	14.7(26)	51.9(92)	28.8(51)	1.7(3)	0.5(1)	1.7(3)	0.5(1)	177
Lower Gander excluding Barry's Brook	20.0(31)	47.1(73)	29.7(46)	1.3(2)	0.6(1)	—	1.3(2)	155
Lower Gander including Barry's Brook	16.1(32)	41.2(82)	33.1(66)	4.5(9)	4.0(8)	—	1.1(2)	199

variation exists among the older year classes (4+, 5+, 6+ and 7+) but the number of fish in the latter year classes was small, numbering less than 10 in each case.

TABLE 4. — Age-length relationship of young salmon in the upper (S.W. Gander River) and lower Gander River. May–August 1951. Figures in parentheses indicate number of fish in each age-class. Italics are calculated lengths (Y = Ax + b; see Text)

Location	Age in years completed							
	1+	2+	3+	4+	5+	6+	7+	
	mm	mm	mm	mm	mm	mm	mm	
Upper Gander	71.3(15)	97.7(91)	113.3(54)	134.6(3)	219.5(2)	209.6(3)	334.0(1)	169
	71.3	*92.3*	*113.3*	*134.3*	*155.3*	*176.3*	*197.3*	
Lower Gander including Barry's Brook	69.3(33)	93.8(80)	112.1(66)	141.5(9)	178.3(6)	171.0(1)	195.5(2)	197
	69.3	*90.7*	*112.1*	*133.5*	*154.9*	*176.3*	*197.7*	
Lower Gander excluding Barry's Brook	68.6(32)	92.5(71)	109.0(46)	136.0(2)				151
	68.6	*88.8*	*109.0*	*129.2*				

Calculated growth rates for upper and lower Gander, using the straight line equation $Y = aX + b$ (where Y = length, X = age, a = slope of the line, and b = the Y intercept) are represented by the equation

$$Y = 21.0\ X + 50.3 \qquad (1)$$

for upper Gander, and for lower Gander with Barry's Brook excluded, because of tributary obstructions (see above).

$$Y = 20.2\ X + 48.4 \qquad (2)$$

When Barry's Brook is included the slope of the line for lower Gander River is increased as shown in the following equation:

$$Y = 21.4\ X + 47.9 \qquad (3)$$

The graph of the above equations is shown in Figure 4.

DISCUSSION AND CONCLUSIONS

The Gander River system, perhaps one of the best salmon producing areas in the whole of Newfoundland, is almost completely free of either man-made or natural obstructions and has available extensive spawning grounds. Density determinations as described in this survey are admittedly crude since the use of a handseine varies not only between individuals, but from one day to the next in the hands of the same individual. As might be expected, however, density is seldom uniform in such a system and varies with the physical conditions in the various parts of the river.

A study of length composition reveals no significant difference ($P>0.05$) in growth between upper and lower Gander River when Barry's Brook fish of the lower Gander are excluded from the comparison. The influence of the Barry's Brook sample is strongly felt when included in the total lower Gander sample and creates a significant difference in growth ($P<0.05$) when

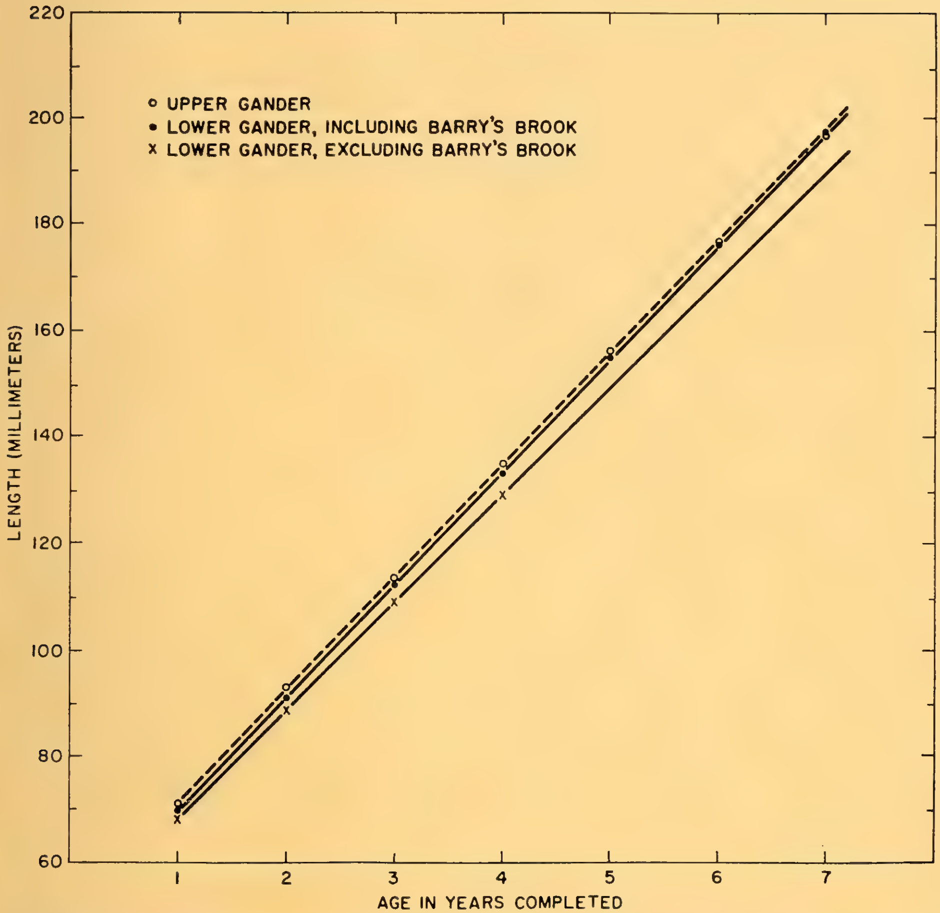

FIGURE 4. Age-length relationship of young Atlantic salmon in the Gander River, summer, 1951.

upper and lower Gander samples are compared. However, because of the unusual conditions of this tributary, with its man-made obstructions, at the time of this survey, it seems best to omit Barry's Brook when comparing growth between the upper and lower Gander areas.

When length is plotted against age only slight variations exist for a given age group between the upper and lower Gander River samples when Barry's Brook is excluded, and intermediate but small differences exist when Barry's Brook is included.

The dominant age-class of 2+ and 3+ years indicate that most smolts in the Gander River migrate to sea in the spring of the fourth year. Lindsay and Thompson (1932) state that Newfoundland salmon spend relatively high number of years (about four on the average) of parr life in the rivers. For

the south and west coast rivers, however, a lower average, one around three to three and a half years was found. Blair (1943) in a study of Atlantic salmon of the east coast of Newfoundland and Labrador found the dominant river age-class to be 4 years for the 1+ sea age-class (commonly called grilse) in all areas except Trinity Bay. For the 2+ age-class he found the river age class to be three years in sections 1 to 5 of the coast (Cape Broyle to Cape St. John) and four years in only one section of the coast (Section 9, Hamilton Inlet, Labrador).

Assuming that these east coast fish are related to the rivers in the area sampled, the predominance of the four year river age-class among the 1+ sea age-class and the fact that smolts leave the Gander system, in the main, in the fourth year, raises the question as to whether or not Gander is primarily a grilse producing river. This hypothesis may be further strengthened by the fact that Dr. A. A. Blair, 1951, reported that of the incoming adult salmon run caught in a wooden fish trap at the mouth of the Gander River in 1951 (9700 fish) 80 per cent of the upstream migrants were estimated to be grilse of six pounds and under.

In the Miramichi River, New Brunswick, Blair (1935) found that "of the four smolt ages among all fish, the three-year smolts were predominant (78.1 per cent) and followed in order by two-year smolts (15.1 per cent), four-year smolts (6.6 per cent) and five-year smolts (0.2 per cent)". Belding (1937) reported that practically two-thirds of the salmon in six rivers of the west coast of Newfoundland, chiefly in St. George's Bay, leave the river at or before the end of the third year. The remaining one-third for the most part leave at the end of the fourth year. Yet Belding refers to these west coast rivers as "small salmon" rivers where grilse are numerous. Murray (1962, mimeograph report) states that in the Little Codroy River of western Newfoundland between 60 and 73 per cent of the smolts have been three year old fish. Thus it seems that west coast Newfoundland smolts behave more like Miramichi smolts than do Gander River smolts with respect to age at migration.

The fact that Gander River parr tend to stay in the river somewhat longer than west coast Newfoundland and Miramichi parr is in all probability related to size at smoltification. Elson (1957) states that "Observations by Canadian investigators indicate that size, or physiological condition associated with size, of parr in their pre-smolt year seems to be a more important factor than age in the change from parr to smolt. As a working approximation an arbitrary dividing line between large parr, likely to become smolts next spring and small parr, not likely to, has been set at about 10 cm. or 4 in. total length, measured from tip of snout to tip of tail." Climatic influence in eastern Newfoundland, particularly the influence of the Labrador Current on temperature conditions would, it seems, tend to delay reaching the prescribed length of Elson as compared with points farther west.

ACKNOWLEDGEMENTS

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UNDERWATER OBSERVATIONS OF THE SQUID *ILLEX ILLECEBROSUS* LESUEUR IN NEWFOUNDLAND WATERS

G. R. WILLIAMSON
Fisheries Research Station, Skek Pai Wan Road,
Aberdeen, Hong Kong

Introduction

LARGE numbers of *Illex illecebrosus* congregate close to the shore of Newfoundland during the warm water months (July to October) of most years. Fishermen catch the squid in a variety of ways, the simplest of which is on jiggers (Figure 1). Some of the squid are used locally as cod bait while quantities are frozen for export.

The specific characters of *Illex illecebrosus* and some habits of the live animals are described by Verrill (1881). The distribution, relative annual abundance, growth, sexual maturity, food and parasites of *Illex* in Newfoundland waters are documented by Squires (1957) who also (1959) discusses the annual migratory movements of the species in the area. Data regarding living squid of numerous species are compiled in Lane's *Kingdom of the Octopus* (1957).

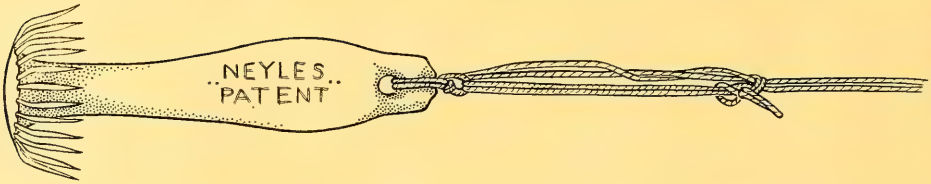

FIGURE 1. A squid jigger. The jigger is made of lead with very sharp unbarbed steel hooks, and is painted red. Weight ca. 110 grams, length ca. 9 centimeters.

The present paper describes observations made by the author whilst diving with snorkelling and SCUBA equipment in the vicinity of the boats of fishermen who were jigging for squid at Holyrood, Conception Bay (August 1961) and at Cuckolds Cove near St. John's (September 1961).

New information is given regarding the behaviour and locomotion of *Illex*, the usage of the tentacles and the use of the jigger device. These observations are compared with those of other workers.

GENERAL DISPOSITION AND ACTIVITY OF THE SQUID

The two localities visited are both commercial 'squid jigging grounds'. At Holyrood, about 200 yards off from the pebble beach, the water is 6 fathoms deep; at Cuckolds Cove, about 100 yards from the rugged cliffs, the water is 14 fathoms deep.

Squid on the grounds during each observation period were always of similar size (the visitors are believed to compose a single year-class) and mantle lengths of samples that were measured averaged 18-22 centimeters in August and 20-24 centimeters in September.

All observations were made in late afternoon and squid were in greatest abundance about 10-15 feet beneath the surface.

Sometimes more than 100 squid were in sight, gently swimming along, sometimes none. The red painted jigger being jerked up and down by the fisherman above would, when squid saw it, be investigated by several individuals in turn, each approaching just close enough to touch it with the tips of their tentacles and arms.

Suddenly one would attack and, like particles of metal to a magnet, up to 30 squid might rush on the jigger from all directions (Figure 2). At least one animal usually became impaled on the hooks and was hauled to the surface while its comrades dispersed.

The squid would continue their interest in the jiggers for anything from a few minutes to several hours, during which time many would be caught. Later, catches would fall off to nothing and a period of inactivity would intervene until another school swam into the area.

MODE OF SWIMMING

A. *Observations*

The squid normally swam tail first. Although it was not possible to see the movements of squid's siphons, the activity of the fins was readily

FIGURE 2. Squid attacking a jigger, as seen from above.

visible and consisted of regular dorso-ventral strokes. When squid were swimming fast, the fin strokes were of large amplitude (Figure 3) but at lesser speeds the movements were reduced to a gentle rippling of the fin edge. The arms and tentacles were held close together in a streamlined cone during swimming, the flanges along the bases of the third pair of arms presumably acting as keels at the rear. The tentacles did not extend beyond the arms but were equal in length to the arms.

Headfirst swimming was only observed when squid were approaching to investigate a jigger. The fins were equally active on these occasions as during normal tailfirst swimming, but their precise mode of usage could not be seen.

The escape reaction of *Illex* was observed many times when I released squid that I had been examining: with powerful jet propulsions, usually accompanied by ink discharge, they accelerated tail-first diagonally downward and out of sight.

To observe the reaction more closely I tethered a squid onto the end of a line, held it in front of my goggles and let it go free. The sequence of its

actions was as follows: (i) It inhaled a large quantity of water into its mantle cavity while the fins sculled and the squid moved slowly backwards and downwards. (ii) A powerful jet was ejected from the siphon simultaneous with a strong down beat of the fins and the squid accelerated away from me. (iii) About six feet from me a second jet was produced and further jets in quick succession carried the squid away from me diagonally into deeper water. Some or all of the jets were accompanied by ink discharge. After the strong downbeat accompanying the first jet the fins appeared not to be used but to be curled in streamlined fashion under the tail.

Having watched the squid escape I had only to haul back the line to retrieve it for further close observation or another demonstration. For observing or photographing of squid's swimming movements this technique is recommended.

To discover further details of the propulsive mechanism several experiments were carried out.

1. The fins of several living squid were cut off with a sharp knife. Upon release, the squid swam away using jet propulsion and attaining a velocity very similar to that of normal squid engaged in the escape reaction. Squid released just beneath the surface and in a horizontal position could be followed for a considerable distance. After swimming some yards they would usually slow down and perhaps even stop, then swim onwards. Despite several stops and starts all squid continued indefinitely on a straight course (save gradually sinking below the surface) and none were seen to change direction. Evidently the removal of the fins seriously reduced the squid's ability to steer.

2. To eliminate the contribution of the mantle to locomotion a large wedge shaped segment, extending ventrally from the anterior mantle edge to a point just in front of the insertion of the fins, was cut out of the mantle of several living squid. The siphon was also cut off. Upon release these severely wounded squid made rather weak flapping movements with their fins and a very slow rearward movement was observed.

3. To determine the relationship, if any, of the movements of the fins and of the mantle and siphon, close observations of tethered squid were made. It appeared that the downbeat of the fins and the contraction of the mantle composed one muscular sequence, which commenced at the tail and moved forwards. A downbeat of the fins usually corresponded to each jet from the siphon.

By holding the body of a squid in one's hand the head-ward direction of propagation of the mantle contractions could easily be felt.

4. Close observations were made of the fin movements of living squid. While the major component of their activity consisted of strokes in a vertical plane (Figure 3) a horizontal component to their movement was also present. This took the form of a wave motion which, during normal swimming, moved head-ward along the fins.

5. Transverse sections of the caudal end of *Illex* were made in order to examine the muscle structure. The fins were shown to be composed of

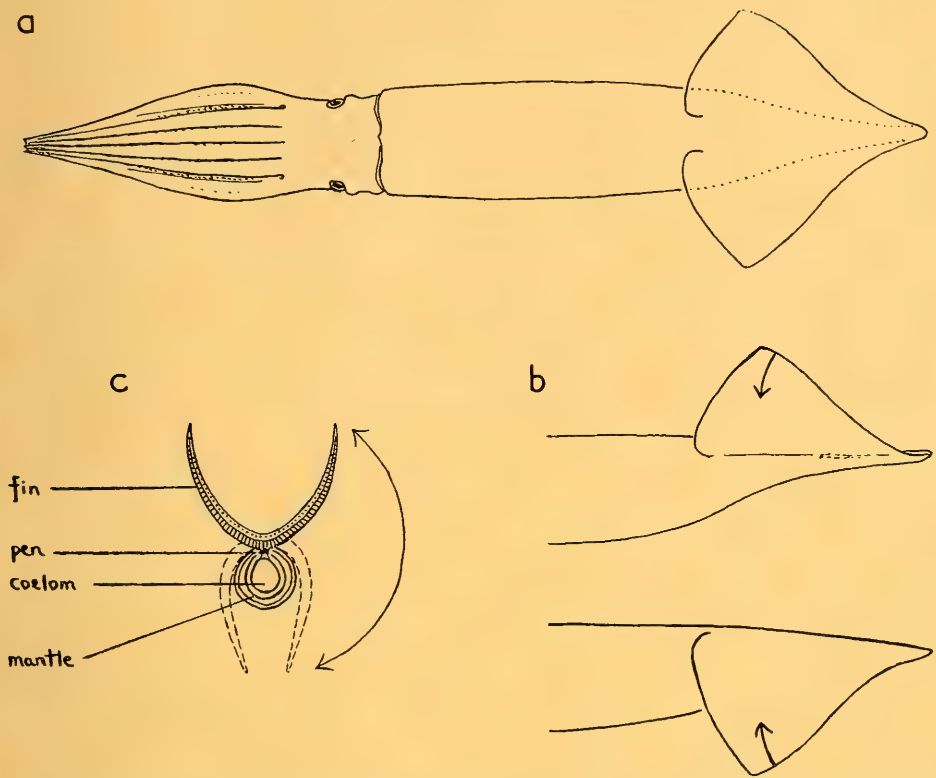

FIGURE 3. (a) Dorsal view of a live squid. (b) The position of the fins at the beginning and end of a large amplitude stroke. (c) TS of caudal region of a squid showing the two muscle layers of the fins and the circular muscles of the mantle, also the maximum arc of movement of the fins.

two opposed muscle layers, one dorsal and one ventral, while the mantle consisted mainly of circular layers of muscle (Figure 3). Both mantle and fins were well supplied with nerves.

B. *Conclusions*

Except in circumstances when the oral appendages are used, such as when closely approaching prey and attacking, *Illex* always swim tail-first. The evidence suggests that the main propulsive force of this strong-swimming pelagic species is supplied by jets of water produced by contractions of the mantle and directed by the siphon.

Steering appears to be controlled at least in part by the fins, which may also contribute to the propulsive force in a manner analagous to the 'wings' of Rajid fishes.

The density of *Illex* exceeds that of sea water, as was demonstrated by cutting the necks of several squid underwater: in all cases the bodies sank

slowly, as did isolated digestive glands also. Possibly the fins perform a function in this connection, their continual activity somehow creating the small lifting force which the animal needs to prevent itself from sinking.

Reconnaisance and attack

The typical method by which a single squid investigated and subsequently attacked a jigger is illustrated in Figure 4. The squid, having noticed the jigger, swam towards it tail-first veering so as to go somewhat past the object of its curiosity at a range of about four feet. It stopped for a moment and, using the fins, swam headfirst gently toward the jigger, apparently still uncertain as to what it was. About two feet from the jigger the squid attacked: shot forwards, presumably by means of a sudden jet from the backwardly directed siphon, and grasped the jigger, opening the arms and tentacles at the last moment.

When numerous squid were in the vicinity, an attack by one usually triggered off a mass attack. Sometimes up to 30 squid would rush into the mêlée to grapple the jigger and on these occasions two or even three squid were sometimes caught on the one jigger. At Cuckolds Cove the squid swam higher in the water toward dusk* and when, around sunset, they were being jigged only 2-3 feet beneath the surface there was great commotion whenever a jigger was raised from the sea. Squid darted at it from all sides trying to catch it before it was removed from the water, some actually shot half out of the water, and it was no trouble for men in the boat to catch specimens with their bare hands.

Although squid which attacked evidently mistook the jigger for some living prey (or were excited into joining a mass attack) by no means all individuals were deceived, especially when the light was bright. Many squid, after manoeuvring to reverse direction, swam gently forwards, touched the jigger with the tips of their oral appendages, recognised an inedible object and retired again. Sometimes a jigger was surrounded by numerous curious squid, each approaching it at irregular intervals to test it, but none attacking.

Colour

The squid appeared semi-translucent and the majority, as seen underwater, were of a pale brownish tint with a brown stripe longitudinally down the middle of the back, though some were whitish. On many occasions a squid calmly swimming across my field of vision would change from brownish to whitish and back again; indeed, the colour of many squid appeared to be undergoing constant modification.

Behaviour of the squid after capture

As soon as a fisherman felt his jigger being attacked he started to haul in the line, rapidly yet steadily. The squid grappling the jigger quickly detected

*Fishermen report that *Illex* do not show a regular diurnal movement with respect to depth. In daylight squid schools sometimes swim deep and on other occasions may be seen lying right at the surface of the ocean. Likewise at dusk, night-time and at dawn, fishermen report the depth distribution of squid to vary greatly from day to day.

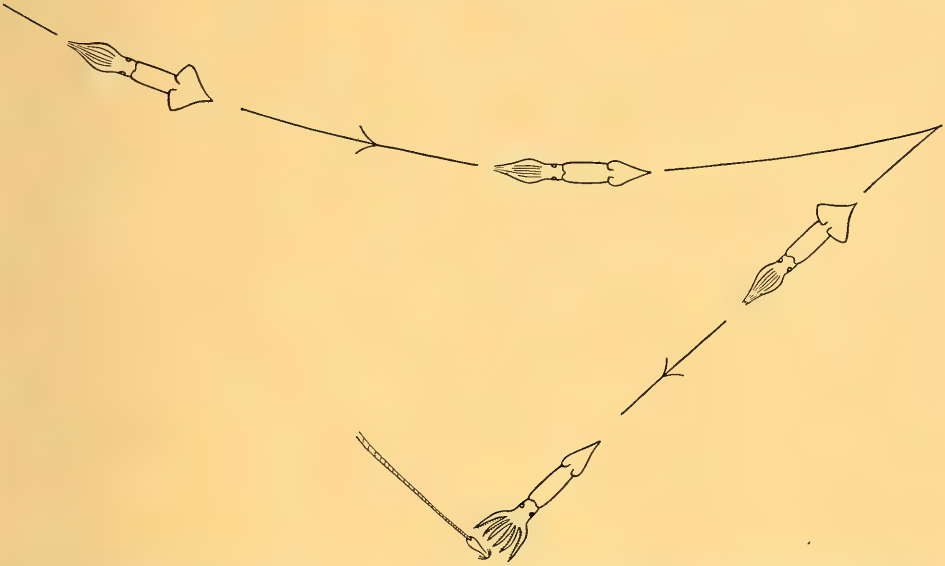

FIGURE 4. Typical reconnaisance and attack on a jigger made by a single squid, as seen from above.

danger and endeavoured to disengage themselves from the needle–sharp (though unbarbed) points of the hooks; the majority with success. But when the hook points had caught into the skin of the buccal membrane of, as was usually the case with at least one individual, a squid was seldom able to escape, so long as the fisherman continued to haul in steadily, and squid so impaled composed of the catch.

As they were hauled toward the surface impaled squid struggled to escape, the puffs of sepia discharged soon causing the underwater scene to resemble an anti-aircraft barrage, but each escape-reaction jet, being directed upwards, only increased the hold of the hooks. Raised finally into the air, squid discharged their mantle-full of water as the powerful inky jet which is so famous a hazard of squid jigging.

In the bottom of the boat the activity of captured squid was remarkable. Blushing with the most vivid colours, particularly orange and purple and with spasms of white, the terrified molluscs made vain swimming actions of the most violent kind. Great peristaltic contractions moved along the mantle and the fins were alternately raised and then powerfully lashed downward. The arms and tentacles grappled any object within range. Squid placed on my hand straightway took firm hold and bit me. No toxic effects were noticed.

DISCUSSION

Observations of squid reported by Verrill (1881) and by the workers quoted in Lane (1957) are confirmed and augmented by the present data.

The schooling behaviour of *Illex* closely resembles the habit of other pelagic squid such as *Onchyoteuthis* and *Loligo* (Lane, 1957).

The rapid and vivid colour changes of which *Illex* is capable parallel the ability demonstrated by many squid genera, e.g. *Loligo* and *Symplectoteuthis*, and other cephalopod groups (Lane 1957). Verrill's (1881) description of the colour of *Illex* hunting mackerel in Massachusetts waters is similar to that observed for the same species on the Newfoundland squid jigging grounds.

With regard to the method of locomotion and steering of *Illex* the conclusions reached are in agreement with those of Verrill (1881). A report (Wilson 1951), that *Loligo* can cruise about indefinitely in an aquarium propelled by beats of the fins aided by weak jets from the siphon, is of interest in that it suggests a reversal of the relative contribution of mantle and fins to the propulsive force. In these closely related genera this seems unlikely and photographs of *Loligo* species (Lane, 1957, plates 16, 32 and colour plate 2) show fin activity almost identical to that seen in *Illex*. It appears more probable that the relative contribution made by the mantle and the fins to the propulsive force varies at different swimming speeds in both *Illex* and *Loligo*. Further investigation is needed to elucidate the matter, but it would appear that, while jet propulsion dominates fast swimming, the relative propulsive contribution of the fins increases as the speed declines and, in both genera, may exceed that of the mantle at very low speeds.

The function of the tentacles of squid is an interesting problem, for the very existence of such remarkable organs demands a specialized use.

Williams (1909) reports *Loligo pealeii* in the attack as shooting out their tentacles in advance when grasping fish in their arms, but I was unable to note this specialized use of the tentacles by *Illex* on the Newfoundland grounds.

Although I did not witness any contacts between *Illex* and fish or euphausiids, the two main groups upon which the species has been shown to feed in Newfoundland waters (Squires, 1957), comparison of my observations with the account of *Illex* catching young mackerel (Verrill, 1881) suggests that the reaction of squid to a jigger is similar to the natural behaviour when feeding on fish. During the initial seizing of a jigger *Illex* does not appear to use its tentacles for any special purpose: they merely function as an additional pair of arms. Should a living prey manage to disengage itself partially, it is possible that the extensible properties of the tentacles might be used to retain a hold until the arms can re-engage.

Photographs of large pelagic ommastrephid squid (Lane, 1957, plates 4, 37 and 38) show similar usage of the tentacles to that noted in *Illex*. Individuals in the act of attacking baited hooks show no noticeable elongation of the tentacles compared with the arms. When an attempt is being made to raise an aggressive 100 pound cephalopod from the water, however, its tentacles are considerably extended, lashing about to grapple the offending gaff.

In both normal swimming and in the attack, the tentacles of *Illex* were of equal length to the arms. Only in the boat when I was trying to disengage squid that were grappling me did the tentacles demonstrate their wonderful capacity for extension. The tentacles also elongated as life ebbed and in *Illex* the long stretched condition of these organs in most dead specimens is apparently as a result of post mortem relaxation of the muscles.

ACKNOWLEDGEMENTS

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OBSERVATIONS ON ANTHOPHILOUS DIPTERA AT LAKE HAZEN, ELLESMERE ISLAND*

J. F. McALPINE
Entomology Research Institute, Research Branch,
Canada Department of Agriculture, Ottawa, Ontario.

INTRODUCTION

IN 1962 THE Entomology Research Institute, Canada Department of Agriculture, began a project, largely concerned with the ecology of arctic insects, at Hazen Camp, a post established in 1957 by the Defence Research Board, Canada Department of National Defence, on the northwest shore of Lake Hazen, Ellesmere Island, N.W.T. (81°49′N., 71°18′W.). Among various studies initiated that season (*see* Oliver 1963), one of my assignments was to investigate the relationships between dipterous insects and the flowering plants occurring there.

Although true flies constitute the predominant element in the insect fauna of the Canadian Arctic (*see* Oliver 1963, McAlpine 1964, and McAlpine 1965), their role as pollinators has received little attention in North America.

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Likewise, the nutritive role of the flowers for these flies has not been systematically studied (Downes 1962). Consequently, even the limited data obtained during my short stay at Hazen Camp (June 16-25) are of more than usual interest, for most if not all of the records concerned are new. More extensive investigations were carried out in the same area during the following summer by Prof. B. Hocking, University of Alberta; the results of his work will be published separately.

To the casual observer, it would probably appear that flies visit flowering plants rather haphazardly, and that they alight on them simply because they afford convenient resting places. However, indications are that this is usually not so. From my observations at Isachsen, Ellef Ringnes Island (McAlpine, 1965) and at Camp Hazen, it appears that many northern species are rather selective in the kinds of flowers they visit and that they usually visit them to imbibe nectar and, in some cases, to consume pollen grains. The data obtained indicate that such feeding habits may be more widespread among the higher Diptera, and more specific in regard to host plants, than in generally realized.

The significance of flower-visiting insects to plants was well expressed by Baker (1963) who said: "For the angiosperms in general the activities of animals as they seek out the flowers and carry the pollen, provides a real advantage over the broad-casting of pollen into the air to be wafted to the appropriate stigma. The advantage is measured by increased certainty of seed production and results in an economical expenditure of energy by reduction in the amount of pollen produced in relation to the number of seeds set." Indications are that dipterous species probably play a very important role in this respect, especially in Arctic regions and other areas where bees are relatively scarce.

It is noteworthy, also, that if particular species of flies seek out particular kinds of pollen and nectar, the presence or absence of certain flowering plants in an area may govern the presence or absence of certain species of flies, and *vice versa*. Hence, the establishment and ultimate geographic distributions of such flies and of the plants that provide food for their adult stages may be more or less interdependent. For example, there is reason to suspect that the two species of mosquitoes that occur at Lake Hazen do not occur on Ellef Ringnes Island because of the absence of *Dryas integrifolia* M. Vahl from the latter (McAlpine, 1965). If, in some cases, such dependence is sufficiently restrictive, it could provide a practical basis for biological control measures.

My field observations were made with a large reading lens. By holding it at arms length the precise activities of the flies could be observed at distances of from 3-6 feet. Though certainly not entirely satisfactory, this method was much superior to attempts to study them with ordinary field binoculars or with the naked eye. For investigations of this kind there is a real need for a simple telescope, perhaps similar to those used on rifles, but with greater powers of magnification. Ideally, one should be able to observe the flies on and in flowers from distances of up to 10 or 15 feet. While certain lethargic species, e.g., some Chironomidae and Empididae, will tolerate being watched at close range, most flies are easily disturbed. When approached, some biting flies

and certain blowflies become more interested in the observer than in flowers, and fast, wary muscids, tachinids, syrphids, etc., are usually frightened off.

An understanding of the basic structures of the various flowers being visited is a prerequisite for meaningful observations on the flies that visit them, and one must also be familiar with the structures of the mouthparts of the flies involved. With this knowledge and some patience and suitable optical equipment the feeding activities of many species can be readily ascertained in the field. However, sight records of flies are usually doubtful, and evidence obtained in the field is probative only if the specimens observed are captured, properly prepared, and positively identified. Therefore, the field observer must locate the fly, keep it under observation (without disturbing it) long enough to ascertain what it is doing in or on the flower, and then capture it before it moves off. Field observations should be repeated, when possible, to ascertain the degree of host specificity of the different species, and to confirm the precise nature of the flies' feeding activities. Ideally these observations should be verified in the laboratory by removing the gut from particular examples and examining the contents, but this is not always feasible for it usually means sacrificing the specimens concerned.

Pollen grains adhering to the bodies of museum specimens are excellent indicators of the flowers visited by them, and it is noteworthy that a great majority of field-caught flies from northern localities are very sparsely to very heavily dusted with pollen; probably 85 to 90 per cent of the netted specimens from the Lake Hazen area have at least a few grains of pollen caught among the hairs on their bodies. Likewise, pollen or nectar in the gut of specimens is positive proof of the food habits of such species (For an excellent introduction to pollen analysis and taxonomy the reader is referred to Erdtman, (1954).

Observations, made at Lake Hazen from June 16-25, 1962, on 19 species of flies on seven species of plants are given below. The insect specimens involved are in the Canadian National Collection of Insects.

Chironomidae

Smittia polaris Kieff.

A few adults were observed imbibing nectar from *Saxifraga oppositifolia* L. on June 16. These fed singly in the bases of individual flowers by inserting their mouthparts into droplets of nectar exuding from the low nectiferous glands between the bases of the stamens and the pistil. All specimens taken were females.

Smittia extrema Holmg.

On June 17 numerous specimens of this species were observed in both staminate (with two nectaries) and pistillate (with one nectary) flowers of *Salix arctica* Pall. Their heads were directed downward and their mouthparts were inserted into the droplets of nectar at the apices of the beak-like nectaries. Up to 12 flies were counted in single catkins. Most specimens were extremely sluggish and were not disturbed even when the catkins were plucked. When examined under the microscope they appeared to be in a state of semi-stupor; if pried loose they were unable to fly and crawled about aimlessly. Their abdomens were fully distended with nectar. Pollen grains were observed adhering to the bodies of most specimens; in a few cases some grains were stuck to their mouthparts. All specimens collected were females.

Other Chironomidae

Larger midges, obviously differing from those above, were seen sipping at nectaries

of *Salix arctica* on two occasions on June 17. However, these were very wary and escaped.

On June 22 several specimens of another much smaller chironomid were seen resting on the stamens of *Dryas integrifolia,* but these escaped also.

SCIARIDAE

Bradysia sp.

On June 24 a single female was taken, while it was imbibing nectar from *Dryas integrifolia.* While under observation the specimen forced itself head first, downward between the stamens to the nectaries and lapped at each nectary within reach of its short, fleshy mouthparts.

EMPIDIDAE

Rhamphomyia filicauda Lundbeck

Many males and females were observed and collected from June 19-25 as they fed on the nectaries of *Dryas integrifolia.* When feeding each fly grasped the stigma of the flower with its hind tarsi and forced its head downward between the stamens. With systematic probing motions, it brought its elongate probosis into contact with nectary after nectary around the flower. These actions were accompanied by continuous pumping motions of the abdomen. After a fly had inserted its head into the stamens, it was not very easily disturbed.

This species was not seen visiting any other kind of flower at Lake Hazen, and it is noteworthy that a long series of *R. filicauda* in the Canadian National Collection from Coral Harbour, Southampton Island, N.W.T., (collected July 17, 1948 by G. E. Shewell) is also from flowers of *D. integrifolia.* At the same time and place, however, the same collector took one male and two females of the same species on flowers of *Salix* sp. (probably *S. arctica*).

Rhamphomyia sp. nr. *lamelliseta*

A single male was observed and captured on June 24 while it imbibed nectar from a flower of *Dryas integrifolia.* The following day a female, which escaped, was seen attempting to take nectar from the nectaries of *Lesquerella arctica* (Wormskj.) Wats. In the latter flower, however, the nectaries are very tiny, poriform openings between the bases of the petals and the stamens, and little or no nectar was in evidence. Both flies behaved in a manner similar to that described for *R. filicauda.*

SYRPHIDAE

Carposcalis carinata (Curran)

Numerous examples of both sexes were observed feeding on pollen grains of various plants as follows: *Dryas integrifolia* (June 18, 19, 22), *Erigeron compositus* Pursh (var. *discoideus* Gray) (June 18, 20), *Salix arctica* Pall. (June 23), *Potentilla chamissonis* Hult. (June 20), and *Erysimum pallasii* Pursh (Fernald) (June 18). Individuals of both sexes were seen imbibing nectar from *Potentilla chamissonis* on June 19-20. Specimens were captured in all the above cases.

This syrphid is very abundant at Camp Hazen and seems particularly strongly attracted to beds of flowering *Dryas integrifolia.* They were commonly seen feeding on fresh pollen grains from newly opened anthers. That they actually consumed pollen was confirmed by J. A. Downes; he dissected the stomach of a specimen, captured while it was feeding on *Dryas* pollen, and found it contained yellow pollen-like material.

To eat pollen the flies rested on the flowers, grasped one filament after another with their front tarsi and pulled the anthers to their mouths; their mouthparts are extremely flexible and the labella were moved about freely in all directions as they fed. It is noteworthy that on several occasions single flies were observed taking pollen from one plant, e.g., *Dryas,* and then moving to a flower of *Potentilla* and taking nectar.

Phalacrodira nigropilosa (Curran)

On June 18, a male was observed forcing its head toward the nectaries in a catkin of *Salix arctica,* but whether it fed or not was not established. Another male was observed feeding on pollen grains of *S. arctica* on June 24; this specimen was captured.

MUSCIDAE

Scatophaga nigripalpis Becker

One male was observed and taken while it fed on pollen of *Dryas integrifolia* on June 24. This fly was lapping at newly-opened anthers with its proboscis. Several thousand pollen grains are still adhering to its hairy body.

Spilogona sanctipauli Malloch

On June 22, a male and a female were observed (and captured) while feeding on the nectaries of *Dryas integrifolia.* These individuals rested on the petals with their heads downward and inserted their mouthparts between the bases of the outer row of stamens. In this way they brought their labella into contact with the nectaries without rubbing their bodies against the anthers. It is noteworthy that both specimens have very few pollen grains adhering to them.

Pogonomyoides segnis Holmgren

Five females of this species were observed (and collected) while feeding on pollen grains of *Dryas integrifolia* from June 19-24. To obtain the pollen, these individuals held the filaments of the stamens (singly) with their two front tarsi and lapped at the anthers with their labella. The bodies of all five specimens are copiously dusted with pollen grains.

One male of *P. segnis* was taken while it fed at the nectaries of *D. integrifolia.* It obtained the nectar in much the same manner as described for *Spilogona sanctipauli,* and, as in that species, there are very few pollen grains adhering to the body of the specimen.

Fucellia pictipennis Becker

A female of this distinctive species was observed taking nectar from a flower of *Dryas integrifolia* on June 25. It alighted on the central portion of the flower and reached the nectaries by forcing its head downward between the outer rows of stamens. Unfortunately, the specimen escaped.

Tachinidae

Murdockiana gelida (Coquillett)

On June 19, a male of this species was observed (and collected) on a flower of *Dryas integrifolia.* It brought its labellae into contact with the pollen on several freshly opened anthers, and gave every indication of actually eating some of the fresh pollen grains. The body of the preserved specimen bears numerous grains of *Dryas* pollen.

Calliphoridae

Boreellus atriceps (Zetterstedt)

On June 19, four females of this species were seen taking nectar from flowers of *Potentilla chamissonis* Hult. on a sunny, gravelly hillside near Skeleton Lake. To obtain the nectar each fly rested astride the flowers and placed its labella against the nectaries; it revolved around each flower pausing momentarily as the labella were pressed against each nectary. While doing this the palpi were extended forward at right angles to the main axis of the proboscis. As the fly finished imbibing nectar from each nectary, it frequently "licked" the base of the petal in a manner reminiscent of a dog licking a plate. One female visited eight flowers in this way over a radius of about five feet in approximately two minutes. Individuals of this species are disturbed if one approaches closer than 5-6 feet, and I failed to capture any of these four specimens. Examination of numerous wild-caught specimens from this locality revealed that their bodies, especially of the females, are frequently heavily dusted with pollen.

Protophormia terraenovae (Robineau-Desvoidy)

This fly was extremely abundant at Lake Hazen, especially around the camp site. Many specimens were seen visiting the catkins of *Salix arctica,* and every specimen collected during the period I was there is heavily laden with (willow?) pollen. However, because of the species' keen sensitivity to the presence of man, I was unable to obtain positive observations on its feeding habits on any flower. Once a person approached sufficiently close to make such observations, the flies were immediately distracted and became more interested in the person than in the flowers they were visiting.

Piophilidae

Allopiophila arctica (Holmgren)

On June 24, five females of this species were observed (and collected) taking nectar from *Dryas integrifolia.* These specimens reached the nectaries in much the same manner as did *Lasiopiophila pilosa* (see below), but there is scarcely a grain of pollen adhering to any of their bodies. This may be due to their much smoother, shinier and more sparsely haired integument. The abdomens of all five specimens are more or less flaccid.

Lasiopiophila pilosa (Staeger)

A single female of this species was observed (and collected) imbibing nectar from

Dryas integrifolia on June 24. It forced its way head first, down between the stamens and inserted its fleshy labella into the droplets of nectar on the nectaries. The abdomen of this specimen was turgid, and after mounting it on a pin, a drop of clear, syrupy, liquid was regurgitated. A few grains of pollen were caught in the hairs of its body.

AGROMYZIDAE

One adult of an unknown species of *Phytomyza* was seen visiting a flower of *Dryas integrifolia* on June 16, but its precise activities were not ascertained.

ACKNOWLEDGEMENTS

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OBSERVATIONS ON CANADIAN BIRCH (*BETULA*) COLLECTIONS AT THE MORGAN ARBORETUM. II. *B. PAPYRIFERA* VAR. *CORDIFOLIA*

W. H. BRITTAIN[1] and W. F. GRANT[2]
The Morgan Arboretum, Macdonald College, P.Q.

THIS PAPER continues our observations on collections of Canadian birches and is concerned with *Betula papyrifera* var. *cordifolia* (Regel) Fern. collected from sites in the Atlantic provinces westward almost to the Manitoba border in northwestern Ontario. The morphological and cytological techniques used in our study have been given previously (Brittain and Grant, 1965).

In *B. papyrifera* var. *cordifolia* we are dealing with an eastern Canadian variety having a geographical range which overlaps, but is not sympatric with that of typical *B. papyrifera.* It is mainly confined to the northern portion of the range of *B. papyrifera,* to mountain sites, or maritime areas where short seasons and low summer temperatures prevail. There, var. *cordifolia* is frequently associated with such species as Black Spruce and tends to grow in thickets along with *B. papyrifera* (*sensu stricto*) and, in the Maritimes and Quebec, with *B. populifolia* and *B. caerulea-grandis.*

Within this range, unlike *B. papyrifera,* the var. *cordifolia* presents a series of relatively stable and uniform characters. Though slower growing than *B. papyrifera,* the trees eventually attain a size equal to the larger of the white birches. These trees are provided with very loose, exfoliating, usually white bark, though individuals with dark brown bark have been observed. It is the fruiting characters, however, that are most characteristic. The porrect lateral lobes of the fertile bracts possess smoothly curved margins, not subquadrangular or subrhomboidal as in many forms of *B. papyrifera.* Even more characteristic, is the long medial lobe with its usually parallel sides not tapering at the apex. This structure sometimes attains to one-half the length of the entire bract (Figure 1). The achenes are larger than those for the average found in *B. papyrifera,* and the styles are very long and slender, from one-half to equal the length of the entire achene or even longer in some specimens. There is a distinct "neck" at the apex, which is more sparcely hispidulous than in most forms of *B. papyrifera.*

Strangely enough, though the cordate leaves are usually cited as the one inevitable characteristic feature of var. *cordifolia,* we find some variations in the character, in that, though in most individuals the leaves are almost or quite uniformly cordate, a greater or lesser proportion are rounded or truncate at the base. In our collecting, these specimens were found most commonly in maritime situations. The possibility that hybridity may be involved in these cases is being studied.

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[1]Scientific Advisor, The Morgan Arboretum.
[2]Associate Professor, Department of Genetics.

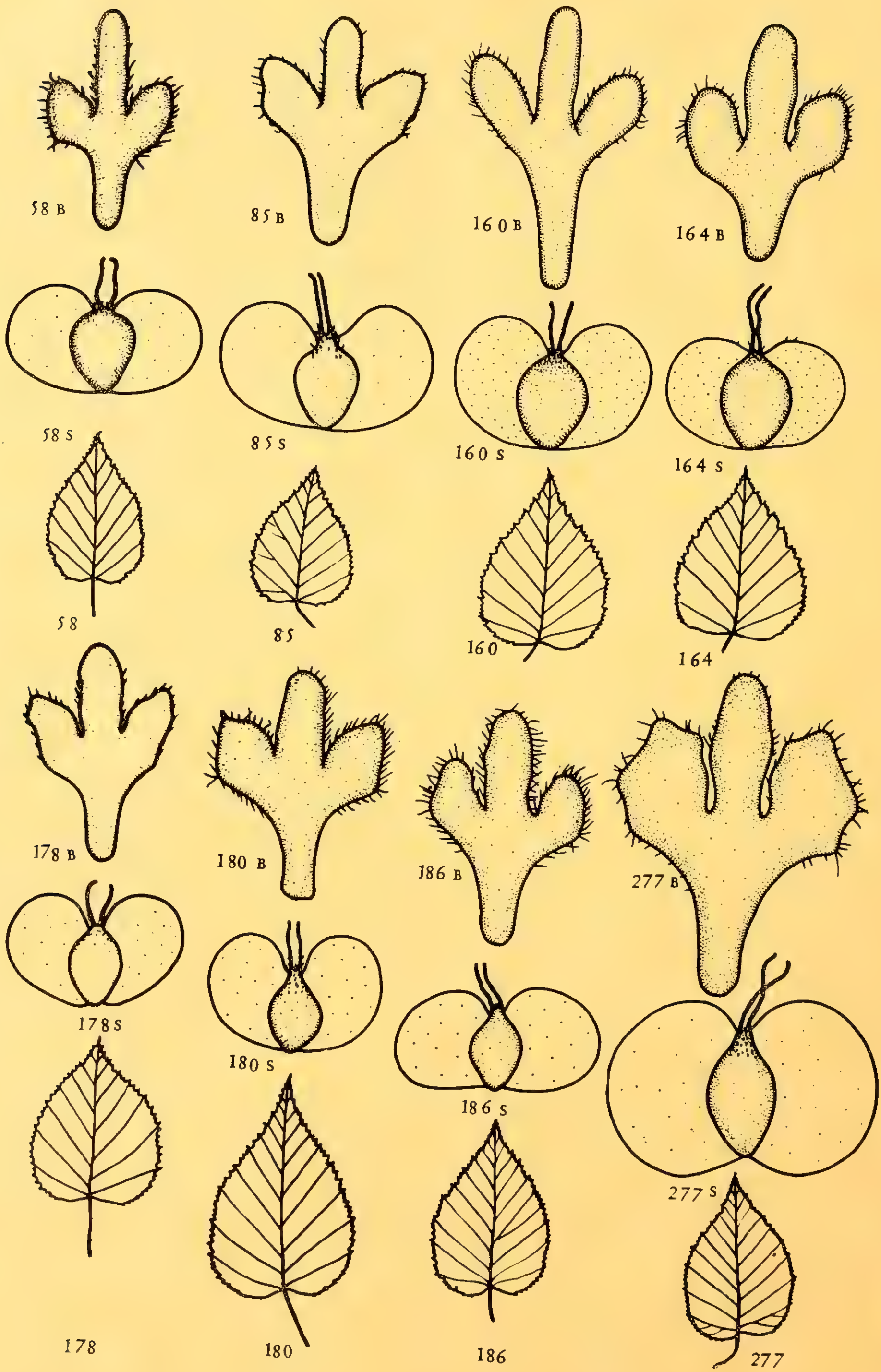
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TABLE 1.—Growth characteristics, stomatal size, and chromosome number of 1-year *B. papyrifera* var. *cordifolia* seedlings in the greenhouse

Acc. no.	Locality	Slight growth or dormant*	Growing actively	Stem and leaf densely pubescent	Stomatal size (microns)	Somatic chromo-some no.
58	Schefferville, P.Q.	+		0	28.69	28
85	Havre St. Pierre, P.Q.	+		0	26.72	28
98	Anticosti Is., P.Q.	+		0	30.47	28
151	Fundy Park, N.B.	+		0	31.31	28
160	Summit Depot, N.B.	+		0	28.59	28
161	Jeffrey, N.B.	+		0	32.25	28
164	Frizzleton, N.S.	+		0	34.88	28
165	Port Hastings, N.S.	.	.	.	.	28
166	Port Hastings, N.S.	+		0	33.56	28
178	Agawa River, Ont.		+	+	29.34	42
180	Catfish Lake, Ont.		+**	+**	33.19	28, 42***
186	Sibley Peninsula, Ont.		+	+	35.16	28
274	St. Phillips, Nfld.	+		0	33.56	28
277	Notre Dame Jct., Nfld.		+	+	34.31	56

*Observations are based, in most cases, on three seedlings for each category.
**For both diploid and triploid seedlings.
***Of three seedlings examined, two were diploid.

Young seedlings of var. *cordifolia* are readily distinguishable from those of *B. papyrifera* in general appearance. In *B. papyrifera* the young stem is characteristically densely pubescent, while those of var. *cordifolia* are, for the most part, sparsely pubescent or almost glabrous. The growth rate of var. *cordifolia* is also much less. As an example, we have taken the linear growth measurements of 10 three-year seedlings from six individual collections of each species. The result was an average figure for *B. papyrifera* of 91.4 cm and for var. *cordifolia*, 66.0 cm. There was no overlapping of the measurements. In the few accessions of five-year seedlings available for comparison, the difference was even more striking. In three collections of *B. papyrifera* the average height of 10 seedlings proved to be 203.0, 304.5 and 335.0 cm, respectively. In the single var. *cordifolia* collection examined, the height varied from 61.0 to 125.0 cm, with an average of 94.5 cm for the ten seedlings.

In this connection, some observations made during the winters of 1963 and 1964 are relevant. In October 1963, a number of seedlings of both *B. papyrifera* and var. *cordifolia* were taken before dormancy was complete and placed in a greenhouse subjected to a night temperature of 16.6°C. All the *B. papyrifera* plants continued to grow actively and all had densely pubescent stems. On the other hand, many of the var. *cordifolia* specimens remained dormant, failing to make any further growth (Table 1). In the fall of 1964, seedlings were allowed to become completely dormant before being placed

FIGURE 1. Representative illustrations of bracts and samaras (x ca. 10) and leaves (reduced ca. 1/2). The numbers refer to accession numbers as given in Table I. S = samara; B = bract.

in a greenhouse with a night minimum temperature of 11.1°C. Under these conditions var. *cordifolia* seedlings after several weeks leafed out and began to grow, but made a much slower start than *B. papyrifera.* The growth behavior of var. *cordifolia* seedlings, therefore, depends upon both previous and subsequent temperature conditions.

The only previous chromosome number reported for var. *cordifolia* is that by Woodworth ($n = 28$; 1929, 1931). From our study the gametic (n) chromosome number for this taxon would appear to be 14 rather than 28 (Table 1). The somatic ($2n$) chromosome numbers of 42 (in two plants) and 56 (one plant) would represent triploid and tetraploid individuals, respectively. Their origins might easily be explained as a result of hybridization and/or polyploidy. Triploid individuals have been found in other birch hybrid complexes (Woodworth, 1931; Johnsson, 1949), but this represents the first report of triploids in the *B. papyrifera* group. The single tetraploid plant ($2n = 56$) found in this study had certain characters which were morphologically greater in size than those of the diploids (Figure 1) suggesting a relatively recent polyploid origin for this individual. The stomatal guard cell measurements, however, fell in the range of other collections with the diploid chromosome number (Table I). Woodworth (1929) in his discussion of var. *cordifolia*, for which he reported $n = 28$, indicated that there were considerable meiotic irregularities. This would suggest that the plant Woodworth examined might also have been of recent polyploid origin and that the chromosome number he reported was not representative of the majority of plants of var. *cordifolia.*

Betula cordifolia Regel in Nouv. Mém. Soc. Nat. Mosc. xiii. 86 – repr. as Mon. Bet. 28, t. 12, figs. 29-36, 1861.

B. papyrifera var. *cordifolia* (Regel) Fernald in Rhodora 47: 320, 1945.

From the foregoing it already seems clear that there is a decided gap between var. *cordifolia* and *B. papyrifera.* In regard to other varieties of *B. papyrifera*, var. *cordifolia* is also distinct. Fernald (1945) states that "were it not for this transitional (variety) var. *macrostachya*, it would be reasonable to look upon var. *cordifolia* as a distinct species, the status originally given it by Regel". We have shown that *B. papyrifera* var. *macrostachya* is morphologically closer to *B. papyrifera per se* than to var. *cordifolia* and that it has somatic chromosome numbers of 70 and 84 as opposed to 28 for var. *cordifolia* (Brittain and Grant, 1965). It does not seem reasonable to regard the variety *macrostachya* as an intermediate form and, therefore, there would appear to be no reason for not reinstating var. *cordifolia* to specific rank – the status originally given by Regel. We, therefore, recommend that *B. papyrifera* var. *cordifolia* be reinstated to specific rank.

SUMMARY

Morphological characteristics, seedling growth habits and chromosome numbers have been determined for collections of *Betula papyrifera* var. *cordifolia* (Regel) Fern. and compared with those of *B. papyrifera.* A somatic

chromosome number of 28 has been determined for var. *cordifolia*, although two triploids ($2n = 42$) and one tetraploid plant ($2n = 56$) were also found. On the basis of the characteristics and differences mentioned, var. *cordifolia* is considered to be distinct from *B. papyrifera* and its varieties, and it is recommended that *B. papyrifera* var. *cordifolia* (Regel) Fern. be reinstated to specific rank, namely as *B. cordifolia* Regel.

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CHANGES IN ELYTRAL PATTERN DISTRIBUTION IN *CHRYSOMELA AENEICOLLIS* (Schaeffer) (Coleoptera: Chrysomelidae)

WALTER ROBERT HENSON
Yale University School of Forestry
New Haven, Connecticut

I RECENTLY PUBLISHED, in these pages, an account of an interesting variation in elytral pattern in *Chrysomela aeneicollis* (Schaeffer). This insect, collected from willow of undetermined species in three locations of the central Canadian Rockies shows a tremendous range in coloration with locality. In addition, there is a distinct difference in the frequency of the various forms in adjacent localities. In the earlier paper (Henson, 1959) it was shown that the frequency of the various patterns was the same in both sexes, that there was no mating bias within copulating pairs and that the frequency of the various patterns was different at Lake Louise, Vermilion Pass Summit and the Junction of Little Yoho Creek and the Yoho River. On the basis of the evidence presented earlier, I concluded that there must be little dispersal between the locations sampled and that the distribution of elytral pattern offered a tool for the investigation of the highly localized and isolated populations of mountain valleys.

TABLE 1. — Color pattern frequency in *Chrysomela aeneicollis*

	Pattern							
	1	2	3	4	5	6	7	8
1957								
Lake Louise	22	8	25	78	3	12	28	31
Vermilion Summit	0	0	8	17	2	4	17	6
Yoho Creek	3	1	14	29	0	3	24	18
1964								
Lake Louise	0	0	6	28	0	8	23	29
Vermilion Summit	0	1	6	23	2	1	11	7
Yoho Creek	0	1	10	22	2	15	12	28

During the summer of 1964, through the kindness of R. F. Shepherd, the 1957 locations were again collected and good series taken for comparison with the earlier material. The insects were examined by the same technique as the earlier series. In addition, the earlier series was resorted and retabulated. The range of coloration was found to be the same in both series. The lack of difference between the sexes was confirmed. On this basis, the data for the two sexes were pooled.

The range of elytral patterns for this insect is illustrated in Figure 1. (reproduced from Henson, 1959). The raw data from the 1957 and 1959 collections is presented in Table 1. In order to avoid zero comparisons, the numbers of insects falling into groups 1, 2, 3 and 4, and those falling into 5, 6, 7, and 8 were pooled. This gave "light" and "dark" group totals for each collection. Tests of independence between collections were made by means of standard two way contingency as outlined in Dixon and Massey (1951).

The 1957 results were first confirmed by means of this modified treatment of the data. It was again established that the areas were different ($x^2 = 7.41$: $x^2.95 = 5.99$). On the same basis, the difference between the areas in 1964 was established ($x^2 = 8.37$: $x^2.975 = 7.38$).

The 1957 data were then compared with the 1964. It was found that the overall total numbers of "light" and "dark" insects were different in the two years ($x^2 = 15.80$: $x^2.995 = 7.88$). It will be seen that the overall change was toward the darker forms.

The collections from each area were then compared. The 1964 collection from Lake Louise contained more dark insects than the 1957 collection ($x^2 = 20.28$: $x^2.995 = 7.88$). The 1964 collection from Vermilion did not contain a different proportion of dark insects ($x^2 = 1.35$: $x^2.90 = 2.71$). The Yoho collection of 1964 was darker than that of 1957 ($x^2 = 4.38$: $x^2.95 = 3.84$).

From these data, it may be seen that the nature of the change in the three areas was quite different. At Lake Louise, patterns 1 and 2 and 5 were lost. At Vermilion one specimen of pattern 2 appeared and at Yoho, pattern 1 was lost while pattern 5 appeared.

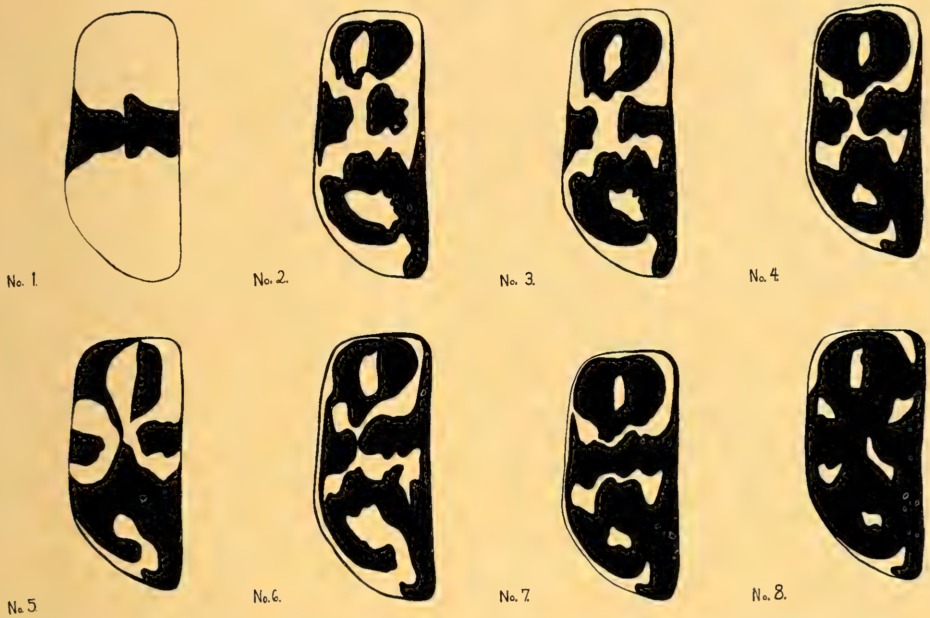

FIGURE 1. Elytral patterns in *Chrysomela aeneicollis* (reprinted from Henson, 1959).

A number of rather similar cases of polymorphism have been described in insects but accounts of the frequency of the various forms through time are surprisingly hard to find. The best case in point seems to be the polymorphism of *Philaenus spumarius* (L.) in Britain (Hutchinson, 1964). Here, collections from three localities were shown to display different proportions of the various forms. In one case, the locality was re-collected after 43 years. The proportion of the various forms had changed over the years but the population remained distinct from that of the other two localities.

In an extensive study of *Tetraopes tetraophthalmus*, Mason (1964) found a considerable degree of variation in six structural and two color characters. The mean values of these characters varied between localities but there was little concordance between the various characters. The color characters showed no variation from year to year within locality but some of the structural characters did show such temporal variation. The amount of variation from year to year was greatest in the peripheral localities and least in the center of the range. Though the localities sampled in the present study are not on the geographical periphery of the range of *C. aeneicollis*, any locality near timberline in the mountains must be considered peripheral. In this sense then, the temporal variation shown in this study is similar to that found in *Tetraopes.*

Carson (1955) and others have suggested that species with extensive ranges are more likely to be rather homozygous on their periphery and rather heterozygous in their central ranges. On this basis, the peripheral parts of

the populations would be less stable from generation to generation because of the lack of "buffering" capacity that heterozygosity provides. This interpretation would not appear to apply to the peripheral populations of *C. aeneicollis* described here. The great variety of coloration in all three populations does not seem to suggest homozygosity.

Two sorts of explanation of the changes in color pattern frequency suggest themselves. Differential predation with the lighter forms selected by the predator would provide a selective pressure that could produce the observed changes. Again, there may be a concordant relationship between color pattern and quite different characters for which selection is progressing at different rates in the three sites.

The variation of elytral pattern in *Chrysomela aeneicollis* remains an interesting problem, now more complex than it appeared to be seven years ago. The earlier conclusion that dispersal between localities is slight appears to hold. It is now apparent that rapid selection and consequent qualitative changes in the local populations is taking place to a different degree in each locality.

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Thoreau on Birds

Compiled and with Commentary by Helen Cruickshank. McGraw-Hill Book Company, New York. 331 pp. (In Canada, McGraw-Hill, Toronto, $9.40).

Mrs. Cruickshank has selected bird material from the vast writings of Thoreau, whose diary alone as published in 1906 fills 14 volumes. Where explanation or correction is needed she gives it in simple direct terms.

These comments are most valuable for bird identification based on the textbooks available to him was difficult and he had numerous problems of this kind, some of which are insoluble. In other cases his descriptions and the present knowledge of the areas mentioned makes it possible for the author to interpret his findings.

Thoreau's study of birds was first at Walden, then the Concord and Merrimack rivers, Cape Cod, and the "Great Northern Wilderness" – Maine. His last journey (1861) was to Minnesota, "the Land of Wild Indians" and it included three days at Niagara Falls.

Thoreau began many serious considerations of nature, his thoughts on conservation and on ecology continue to ring true. His sentimentalism and poetic mind probably led to his dictum: "I hate museums (what is this reviewer doing here?) – they are dead nature collected by dead men." He did not care for scientific organizations and did not join the Association for the Advancement of Science when invited. Perhaps he would feel more kindly to the modern museums which have become our greatest natural history educational institutions.

Useful inclusions are extracts and illustrations from the bird books Thoreau used, a list of Thoreau's birds, and a selected bibliography.

Mrs. Cruickshank has done a great service by leading us back more than a hundred years to Thoreau and letting us learn as he learned about natural history. Both Thoreau students and nature students will benefit.

Hoyes Lloyd

582 Mariposa Avenue
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Audubon's Wildlife

By Edwin Way Teale. The MacMillan Company of Canada Ltd., Toronto. 1964. 256 pages, 28 colour plates, 78 full page black and white reproductions. $18.75.

In order to learn what the American wilderness was like a century ago, Edwin Way Teale takes a new look at the work of the famous artist-naturalist, John James Audubon. Through carefully selected passages from Audubon's Ornithological Biography and a hundred or more well-chosen reproductions of the artist's work, we get a vivid picture of what the early frontier must have been like.

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OTHER NEW TITALS

Published Writings of Edward Alexander Preble (1871-1957)

By W. L. McATEE and FRANCIS HARPER. Museum of Natural History, University of Kansas, Miscellaneous Publication No. 40, pp. 1-16. 1965. An individual may obtain a copy gratis by requesting the same from the Museum of Natural History, University of Kansas, Lawrence, Kansas, 66045, or by writing to Francis Harper, 311 McCauley Street, Chapel Hill, N.C. 27514.

Travaux en cours en 1963

Service de la Faune du Québec. Rapport No. 3. Ministère du Tourisme, de la Chasse et de la Pêche, Province de Québec, Décembre 1964. 468 pp.

A Note on the Production of this Journal

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